METAL FINISHING

PREPARATION, ELECTROPLATING, COATING

PUBLISHED FOR THIRTY-SEVEN YEARS AS METAL INDUSTRY

BURRS.... BURRS.... BURRS

Burrs everywhere, but

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THE LEA METHOD AND MATERIALS
remove them easily and economically

Cuno Engineering Company of Meriden, Connecticut makes oil filters . . . those highly efficient filters used on airplanes and tanks. And their efficiency is due in large part to the successful utilization of the principle of "edge filtration". Oil passes between specially shaped discs compressed almost solid on rods.

Where does burring come in? It is absolutely essential that every potential tiny particle of metal be removed before the filter is assembled and placed in operation. Should any tiny particles within the filter drop off, they would, of course, defeat the very purpose for which the filter was installed.

Note the many burrs in the castings pictured above. Imagine the task this would be if all the work were done by hand. Imagine the difficulty of maintaining tolerances in the measurements, if the burring were done with files or metal burrs.

Here is an excellent example of the way LEA Engineers help manufacturers. Cooperating with Cuno production officials, they worked out a simple, effective and economical method for removing all burrs not only on the castings but on the discs.

Why not investigate the LEA Method of Burring for your operations?

THE LEA MANUFACTURING CO.

WATERBURY, CONN.

Burring, Buffing and Polishing . . . Specialists in the Development of Production Methods and Compositions

2-LM-2

ARY, 1943—41st YEAR

FEB 13 1943

"CLEPO EXPEDITING SERVICE for WAR MATÉRIEL!"

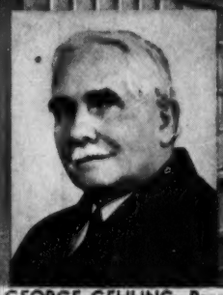
THESE CLEPO EXPEDITERS HAVE THE ANSWERS TO YOUR PROBLEMS

. . . . . at their finger tips

ROLAND DUCETTE, Field

R. R. SIZELOVE

J. R. GUMM



GEORGE GEHLING, Penn.

Consult any of these men for Information on

1. Deburring arms components, motor parts, fuze parts, etc.
2. Proper way to prepare Aluminum for spot-welding.
3. Aluminum preparation for Anodizing.
4. Hy-Speed cleaning of Brass and Steel shell cases.
5. Smut removal of steel for Cadmium, Hy-Speed Copper, Zinc, and hard Chromium plating.
6. Bonderite, Parkerize or Lubrite metal preparation.
7. Steel projectile cleaning.

. . . and any other information you desire.

WM. VOSS, New York

J. HONNECKER, Ohio

J. BARRY, Conn.

RAY BERGHOLD, New York

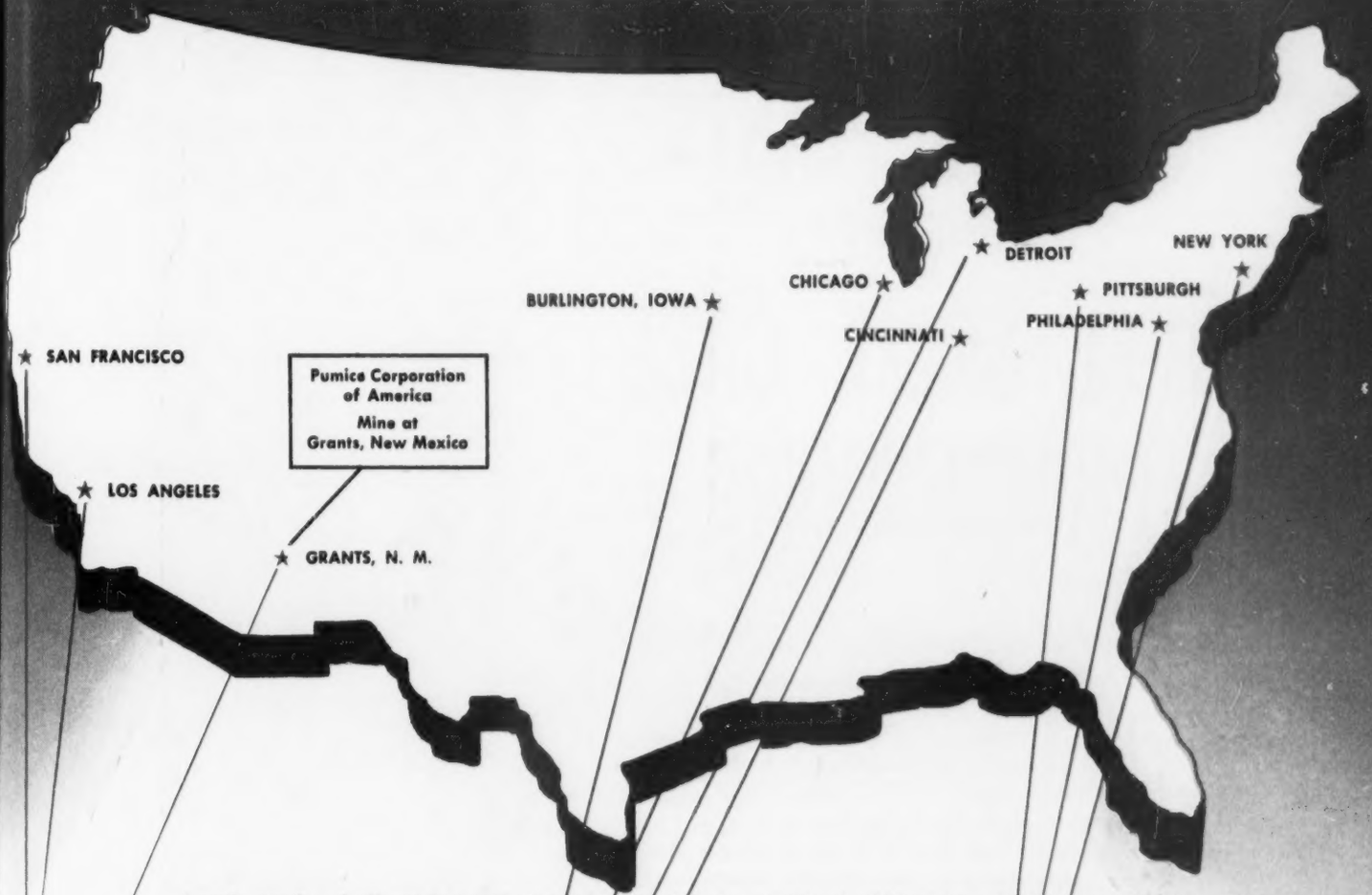
E. JEVELY, Mass.

R. TUTTLE, New York

FREDERICK GUMM CHEMICAL COMPANY, Inc.

538-542 Forest St., Kearny, N. J.

NATION-WIDE DISTRIBUTION OF
America's Own Valencia Pumice



Ample stocks of all grades and sizes of Valencia—the standard of American Pumice—carried in the following locations assure prompt shipments of any quantity from a pound to car-load lots.

BRAUN-KNECHT-HEIMANN CO.
1400 16th Street
San Francisco, California

BRAUN CORPORATION
Box 2262, Terminal Annex
2260 East 15th Street
Los Angeles, California

PUMICE CORPORATION OF AMERICA
Grants, New Mexico

McKESSON & ROBBINS, INC.
109 North Fourth Street
Burlington, Iowa

THE HARSHAW CHEMICAL CO.
445 Lake Shore Drive
Chicago, Illinois

THE HARSHAW CHEMICAL CO.
9240 Hubbel Avenue
Detroit, Michigan

M. J. DALY COMPANY
605 Gerke Building
Cincinnati, Ohio

COLONIAL SUPPLY CO.
217 Water Street
Pittsburgh, Pennsylvania

CHARLES A. WAGNER CO.
813-815 Callowhill Street
Philadelphia, Pennsylvania

WHITTAKER, CLARK & DANIELS INC.
260 West Broadway
New York City

Valencia, a true pumice stone, is mined at Grants, New Mexico, from an inexhaustible deposit. It is not to be confused with volcanic ash or other materials of a similar nature that are erroneously called American pumice. Volcanic ash (silica particles) is entirely different from true pumice and cannot be expected to yield the same results. You will find that Valencia is superior to any other pumice, either foreign or domestic. Valencia has set a new standard by which other pumices will be measured. Note comparative Chemical Analysis.

Hourly tests at the mine and rigid production control assure uniformity of particle size, purity, weight and color. For samples and prices contact your nearest distributor or write us direct.

★ ★ ★

Comparative Chemical Analysis

	Valencia Pulverized Per Cent	Italian Select Per Cent
Silica	72.90	73.24
Alumina	11.28	10.61
Iron Oxide	.86	1.57
Titanium Oxide	.06	.10
Calcium Oxide	.80	1.10
Magnesium Oxide	.36	.40
Soda	3.64	3.03
Potash	4.38	5.58
Sulphuric Anhydride	.03	.05
Loss on ignition	5.20	4.04

★ ★ ★

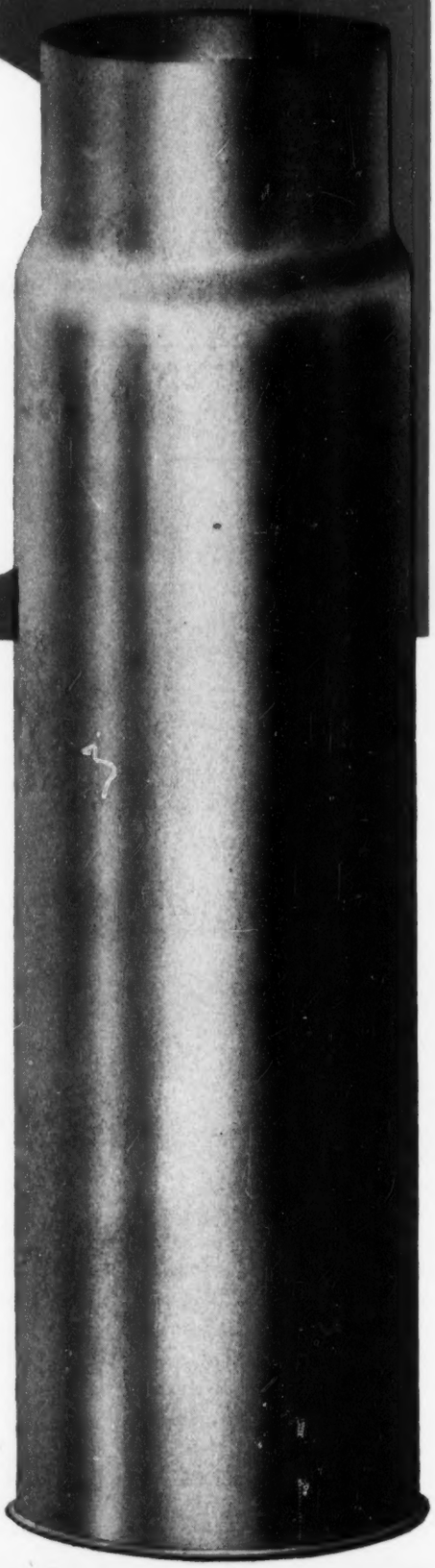
3619

PUMICE CORPORATION OF AMERICA

GRANTS · NEW MEXICO · U. S. A.

New York Office: 260 West Broadway

HELP FOR PLANTS GOING INTO STEEL SHELL CASE PRODUCTION!



It has been our privilege to cooperate with a number of plants now planning for or actually engaged in the production of steel shell cases. In the interests of saving time and speeding production, we offer that experience to any plant engaged in this work.

One problem on which our Technical Service Engineers have assisted is in the drawing operations performed on these cases. In the initial cupping operation, for example, Oakite Drawing Compound provides the right lubrication required, facilitates stripping of work from die, contributes to greatly increased die life.

Quite important, too, is the fact that this Oakite material is readily removed in subsequent cleaning operations. Further research and field work on the various other drawing operations has resulted in the accumulation of data which, we believe, can be used to advantage in a study of your drawing problems.

Oakite experience has also been helpful in degreasing steel shell cases before applying protective finishes. On this operation, fast-working Oakite materials provide the CHEMICALLY CLEAN surfaces required before final finishing.

If we can be of service on any phase of this work or on any of the important operations listed, 'phone, write or wire us today!

LET US GIVE YOU TECHNICAL HELP ON THESE AND SIMILAR OPERATIONS!

1. Cleaning and preparing shot and shells for painting
2. Machining shell component parts
3. Rust-proofing gun parts between manufacturing stages
4. Degreasing bomb parts prior to plating
5. Cleaning rifles and guns after proof-firing
6. Removing heat treat scale

Manufactured only by
OAKITE PRODUCTS, INC., 18 Thames Street, NEW YORK, N. Y.
Representatives in All Principal Cities of the U. S. and Canada

OAKITE
MATERIALS METHODS SERVICE

CLEANING
FOR EVERY CLEANING REQUIREMENT

METAL FINISHING is Published monthly by The Metal Industry Publishing Company, 11 West 42nd Street, New York, N. Y., U. S. A.
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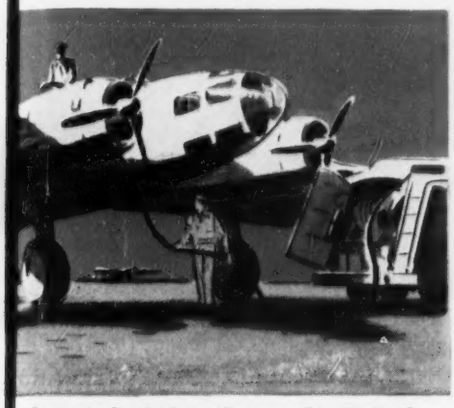
Rubber WILL RIDE TO VICTORY ON THE SEVEN C's

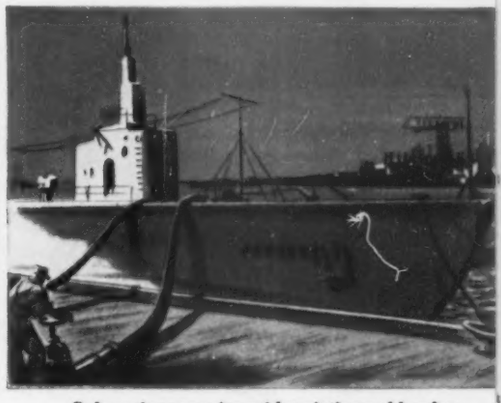
THE "Seven C's" are ***Conservation***, to salvage all rubber for re-use; ***Care***, to make what we have last longer, do more; ***Cooperation***, in use and allocations; ***Compounding***, to produce the best mechanical rubber goods within the limits of supply; ***Construction***, of fabric and reinforcement so that less rubber may do more; ***Collaboration***, of the entire Rubber Industry for the good of all; ***Courage***, to pursue research and development relentlessly.

The entire mechanical rubber industry is applying its collective ingenuity, experience and skill from laboratory to shipping platform with results which, at times, may look like miracles to anyone unfamiliar with the sustained research which is an inherent part of the story of Rubber.

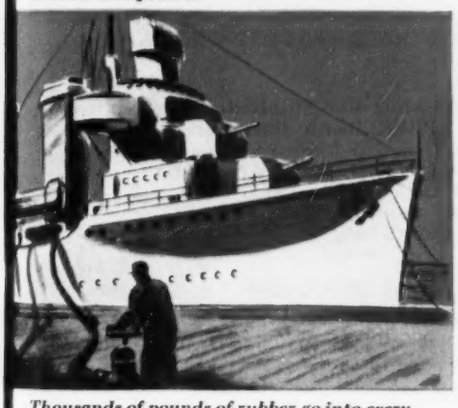


In a single airplane there are hundreds of rubber parts, including hose for fuel, oil lines and hydraulic controls; packings, and vibration dampeners.

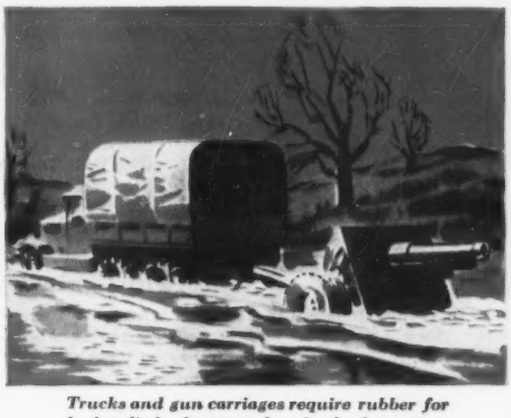
Tanks need rubber at many points—rubber that will withstand heat, cold, oil, abrasion.



Submarines require acid-resisting rubber for battery compartments; other kinds of rubber in gaskets, mountings, and for scores of special applications.



Thousands of pounds of rubber go into every warship at hundreds of places from propeller shaft to gun decks and fire control tower.



Trucks and gun carriages require rubber for hydraulic brake parts, for shock absorption, and for other vital uses.

50th YEAR OF RESEARCH

THE half century mark now reached at MANHATTAN finds the thousands who work within its several plants too busy to take full note of this milestone in a long record of achievements. Among these are: Compensated Power Transmission Belting in which all plies have equal stresses; the Extensible Tip for prolonging the life of endless belts; the Homoflex hose construction principle which increases the flexibility and multiplies the life of rubber hose—often many times; Radio-Active treated fire hose that resists mildew; first to adapt synthetic rubber in oil-proof rubber products; Vibration Dampener Bushings for portable grinding wheels.

These are but a few of the MANHATTAN developments which are contributing to conservation of rubber by prolonging service life, and to greater production.

THROW YOUR SCRAP INTO THE SCRAP!

KEEP AHEAD WITH MANHATTAN

THE MANHATTAN RUBBER MANUFACTURING DIVISION
of RAYBESTOS-MANHATTAN, INC.
EXECUTIVE OFFICES PASSAIC, NEW JERSEY

Fit for war service

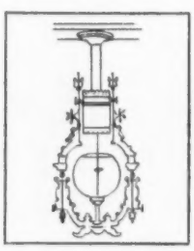
With new motors and plating generators hard to procure, it is doubly important to check up on those we have—to make sure they are fit for war service —continuous operation, overloads without babying or tinkering.

A good tonic for most motors that falter in strenuous service is a new set of brushes—not any set, but one chosen specifically for the job. Anybody can guess at what brush characteristics are best. Many will guess right. More will guess wrong. Why guess? Get the scientific recommendation from SPEER—easy to get, no obligation involved. Merely do this: Ask for as many SPEER Brush Data Forms as you have machines you would like to improve. Send the forms to SPEER. Back to you will speed recommendations based on forty years of commutation engineering. The rest is up to you. SPEER is ready to give this service freely to help speed production and total victory for freedom-loving peoples.

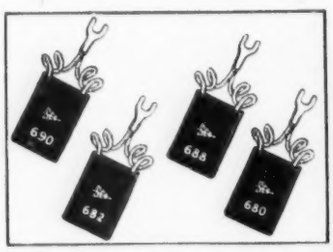
PROMOTE COPPER SALVAGE

Save the shunts and connections from discarded brushes. This helps to salvage copper needed for war material. Keep it moving to your salvage dealer as fast as it is accumulated.

Famous American Firsts



Arc Lamp, 1878



SPEER BRUSHES For the newer interpole platers — SPEER Grade 680. For the older non-interpole machines—SPEER Grade 682. For the very old machines converted from gauze to block brushes — SPEER Grades 688 or 690.
There is one right brush grade for every job—and SPEER makes it.

SPEER
CARBON COMPANY
ST. MARYS, PA.
CHICAGO · CLEVELAND · DETROIT
MILWAUKEE · NEW YORK · PITTSBURGH

3362

OFFICIAL O.W.I. PHOTO

IT'S A TREMENDOUS JOB YOU'RE DOING, MR. NELSON

Incorporated 1850

Pennsylvania Salt Manufacturing Co.
Manufacturing Chemists.
Widener Building
Philadelphia

Leonard T. Beale
President

December 19, 1942

Mr. Donald M. Nelson
Chairman, War Production Board
Washington, D. C.

Dear Mr. Nelson:

It is a tremendous job you are doing. And a remarkably successful one to date, as evidenced by the huge volume of vital war supplies that is now rolling off American production lines.

From our position as but a single unit in the vast industrial march to victory, we have some appreciation of the immense problems and responsibilities that you and the War Production Board face in coordinating national production.

We know the task has just begun. We realize the imperative need of teamwork and cooperation. In supplying essential chemicals to key war industries we sometimes feel that we are playing only a limited part in the war program -- although there is no limit on our effort.

We are gratified, however, when we receive reports from the field showing how our products have helped do a better and faster job of turning out materials for war. One such routine serviceman's report read, in part, "Pennsalt Cleaner saved this large steel fabricating plant over 5000 lbs. of zinc per week in a galvanizing operation. Production was speeded 25% by reduction of rejects."

While this is just one example, it illustrates the kind of job we like to do.

Yours for Victory,

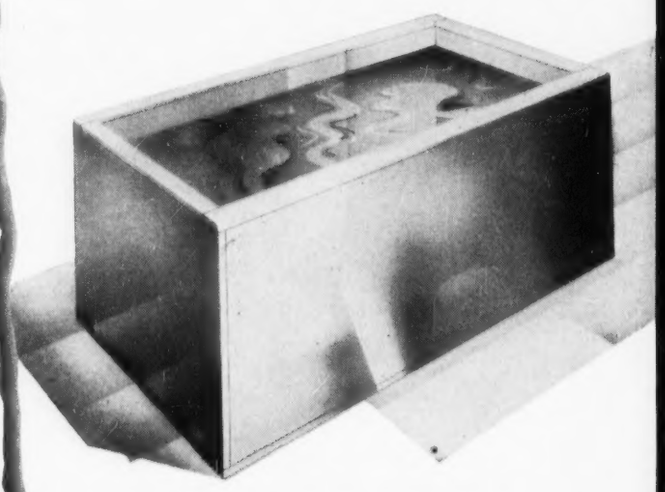
Leonard T. Beale

PENN SALT
Chemicals

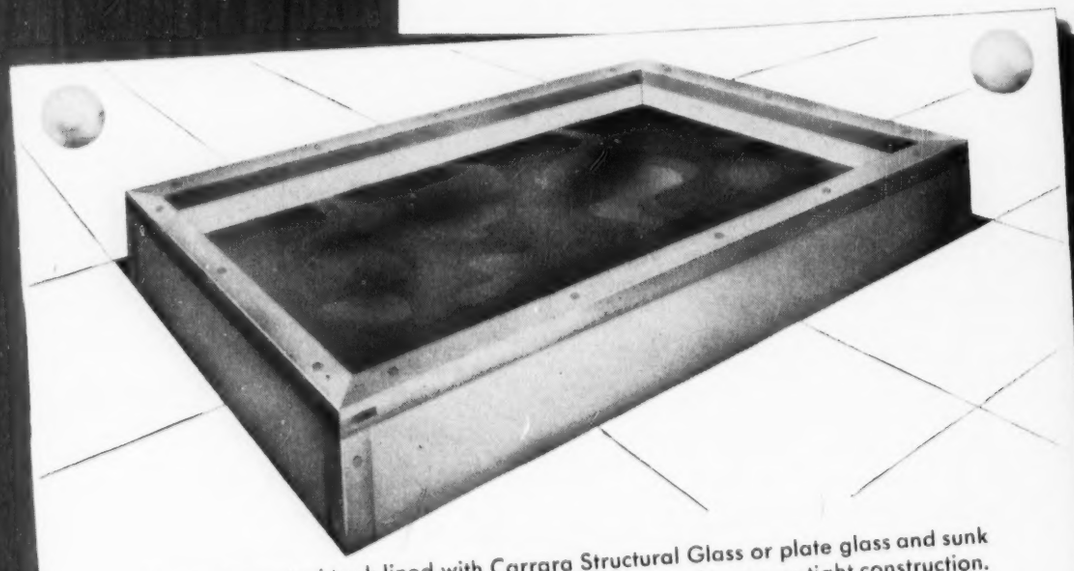
ANNOUNCING

Glass Tanks

BY "PITTSBURGH"
TO HANDLE ACIDS,
ALKALIS, CHEMICALS



A typical free-standing, all-glass tank, constructed entirely of Carrara Structural Glass, or of transparent plate glass if desired



A typical chemical tank lined with Carrara Structural Glass or plate glass and sunk into the floor. Outside casing is wood. Tie-rods are used to assure tight construction.

HERE'S the best answer yet to tank problems! Chemical tanks of Pittsburgh Glass . . . practical, efficient, reasonable in cost, and *promptly available!*

No other material rivals glass in its combination of desirable properties for chemical tank purposes. Glass has always been non-porous, non-absorptive. It won't rot, won't contaminate chemicals it comes into contact with. And now, since we can temper glass, it is also strong enough and resistant enough to thermal shock to provide a *permanent* chemical tank.

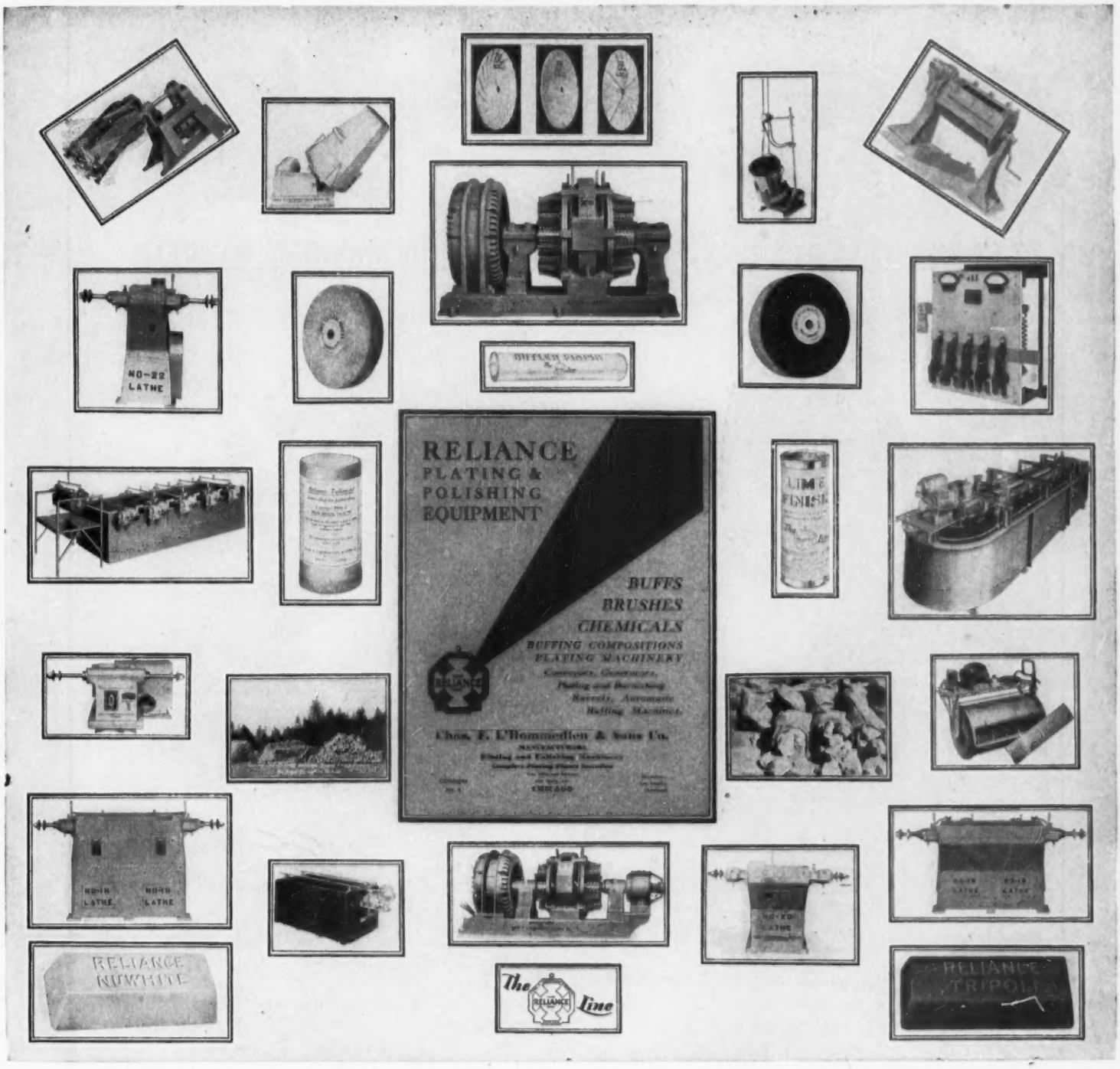
Tanks of Pittsburgh Glass require minimum maintenance. They can be built as complete, free-standing units, of opaque Carrara Structural Glass or of transparent plate glass. Or we can have our own crew of men *line* your present tanks with glass, no matter what their size or capacity.

Whatever your use of chemical tanks, investigate these sensational glass tanks by "Pittsburgh." Write us explaining briefly your requirements, and let us work with you on the application of glass tanks to your special needs. Pittsburgh Plate Glass Company, 2033-3 Grant Building, Pittsburgh, Pennsylvania.

PITTSBURGH PLATE GLASS COMPANY

★ ★ ★ "PITTSBURGH" *stands for Quality Glass and Paint* ★ ★ ★

PLATING & POLISHING EQUIPMENT



Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS of

Plating and Polishing Machinery

Complete Plating Plants Installed

C. B. Little
Newark, N. J.

W. R. Shields
Detroit, Mich.

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Philadelphia, Pa.

Gen. Office and Factory:
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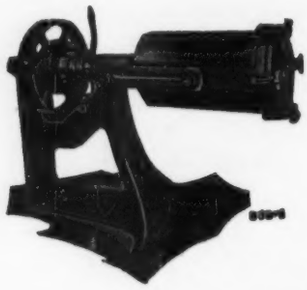
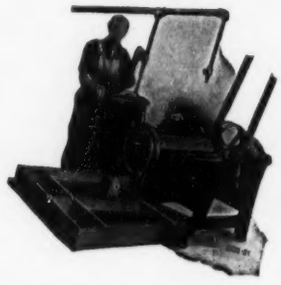
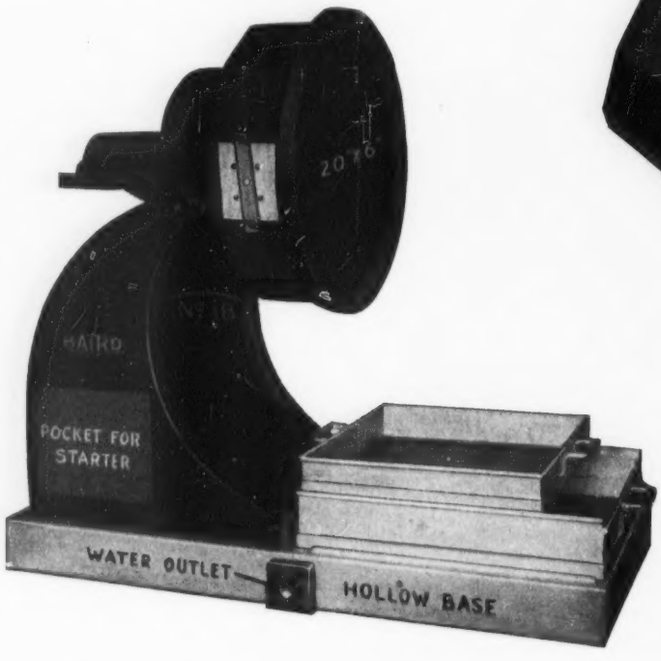
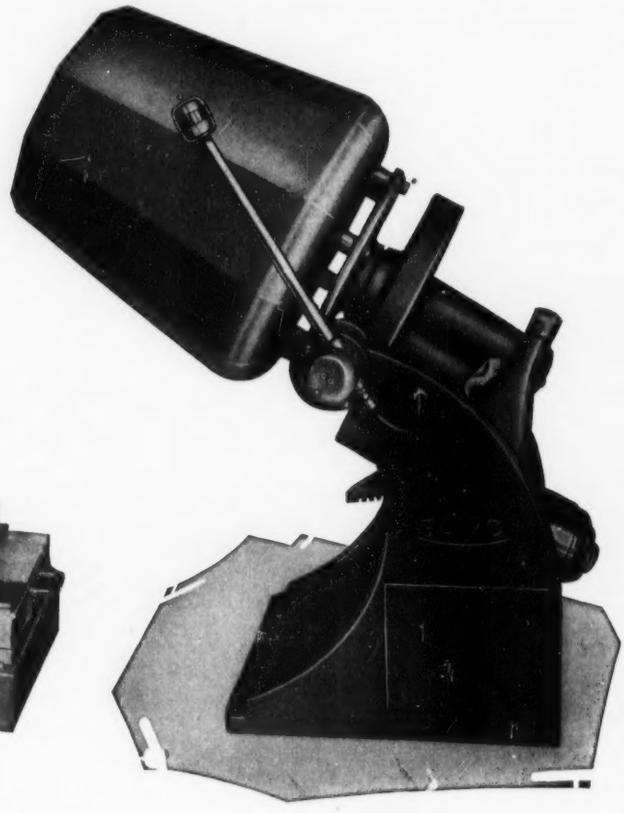




HORIZONTAL BARRELS **TILTING BALL BURNISHING BARRELS**





This shows a High and Narrow Type of Barrel mounted on "Baird" Model D, or Pedestal Type Motor driven Oblique Tilting Tumbler.

As shown the barrel was lined for use for burnishing with hardened steel balls.

These barrels may be of any suitable material depending on the job. Cast iron or fabricated steel unlined or lined with rubber etc. for rolling in abrasives.

Made in 20" dia. x 6" for No. 1 Tumbler
Made in 24" dia. x 8" for No. 2 Tumbler

This shows the side of a No. 1 BAIRD Model D. Single Oblique Tilting Tumbler with a No. 22 Sheet Steel Polygonal Barrel and with an Automatic Electrical Tilting Device.

This device AFFORDS GREATEST SAFETY—LEAST LABOR—LEAST FLOOR SPACE—LEAST AMOUNT OF DISTANCE TO MOVE WORK in USING the tumbling barrels. SAVES TIME AND FLOOR SPACE.

When tumbling questions come up "ASK BAIRD ABOUT IT"

THE BAIRD MACHINE COMPANY

BRIDGEPORT, CONNECTICUT

Since 1846 specializing in high production machinery for articles of wire and for ribbon metal. Also machines to turn, bore, etc., castings, forgings, etc., up to 10½" diameter.

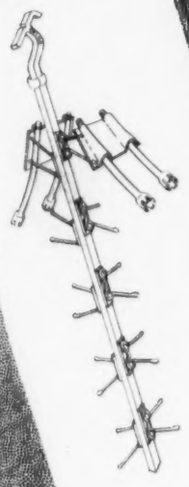
BELKE'S

Answer for PLATING *and* ANODIZING SMALL PARTS

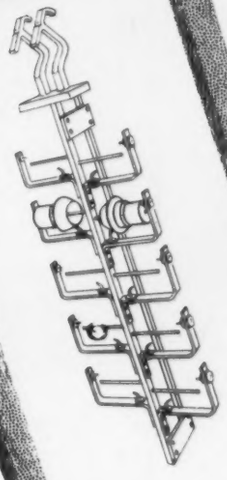
FOR ANODIZING SMALL PARTS

Specially designed Tube Type Anodizing Rack with spring tension, easy to load and unload. Handles large volume of small parts with each batch.

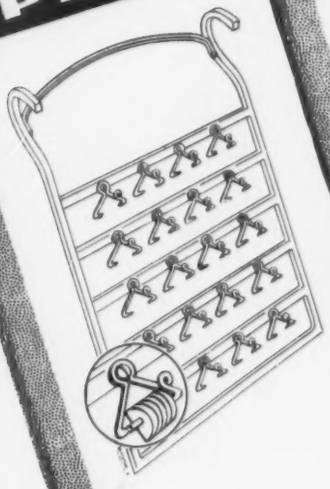
• FOR PLATING •



10-H Type Insulated Rack for Cadmium or Zinc Plating special ordnance parts. Contact springs made of bronze wire (removable).

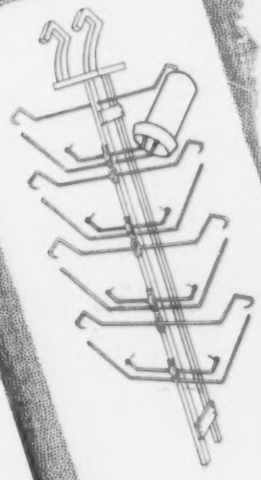


10-H Type Inside Plating Rack with Cathode and Anode constructed in one unit specially designed for inside plating large fuse parts.



Belke Arch Type Zinc Plating Rack designed for zinc plating condenser parts.

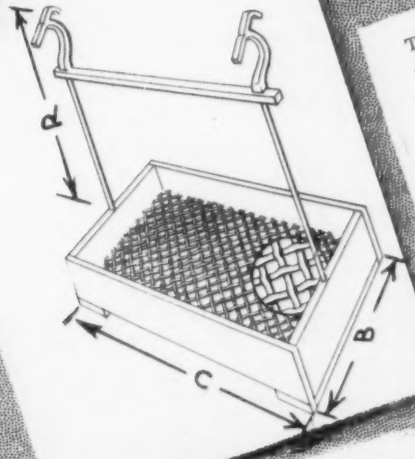
12-H Type Cathode and Anode Rack for inside and outside plating of fuse body parts.



8-H Type Rack for side and outside plat of extra large ordn parts.

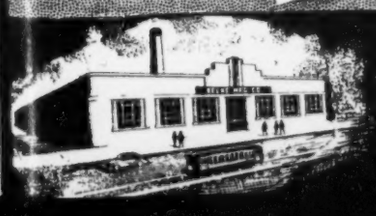
FOR PLATING SMALL PARTS

A real money saving and handy plating basket for plating small quantities of miscellaneous parts. Has Bakelite frame with removable screen mesh bottom. Nothing takes plate except articles in bottom. Will not shade work. Sturdily constructed and will give years of service.



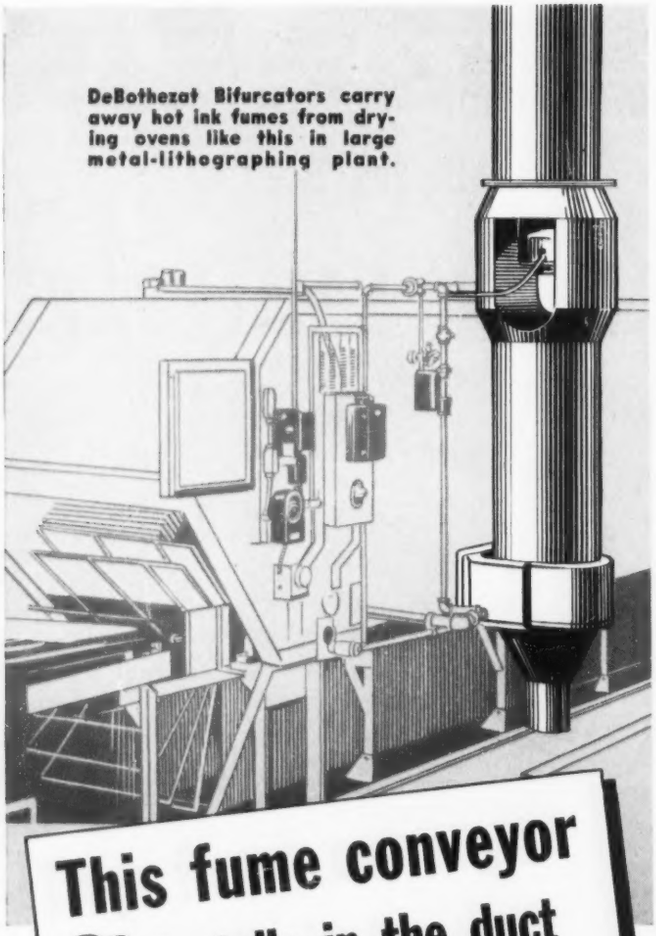
The above illustrated Plating and Anodizing Racks are only a few of the many designs we are supplying the Plating Industry.

All Belke Inside Anode Plating Rack Designs patented—No. 179,837.



BELKE MFG. CO.

947 N. CICERO AVE., CHICAGO



DeBothezat Bifurcators carry away hot ink fumes from drying ovens like this in large metal-lithographing plant.

This fume conveyor installs in the duct

YOU CAN INSTALL DeBothezat Bifurcators in any position from horizontal to vertical . . . and *right in* the duct! This feature *eliminates* elbows, bends and supporting platforms. Bifurcators are supported like any length of ordinary duct work.

MOTOR ISOLATED FROM FUMES in a through-ventilated chamber. Motor is easily accessible for inspection.

MOTOR PROTECTED against burning out by non-overloading power characteristics of the DeBothezat fan.

Send for Interesting FREE Bifurcator Book

De Bothezat

VENTILATING EQUIPMENT

Division of
American Machine and Metals, Inc., East Moline, Ill.

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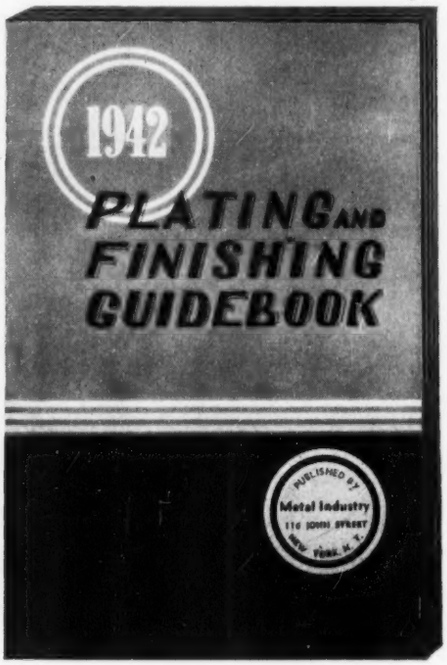
PLATING and FINISHING GUIDEBOOKS



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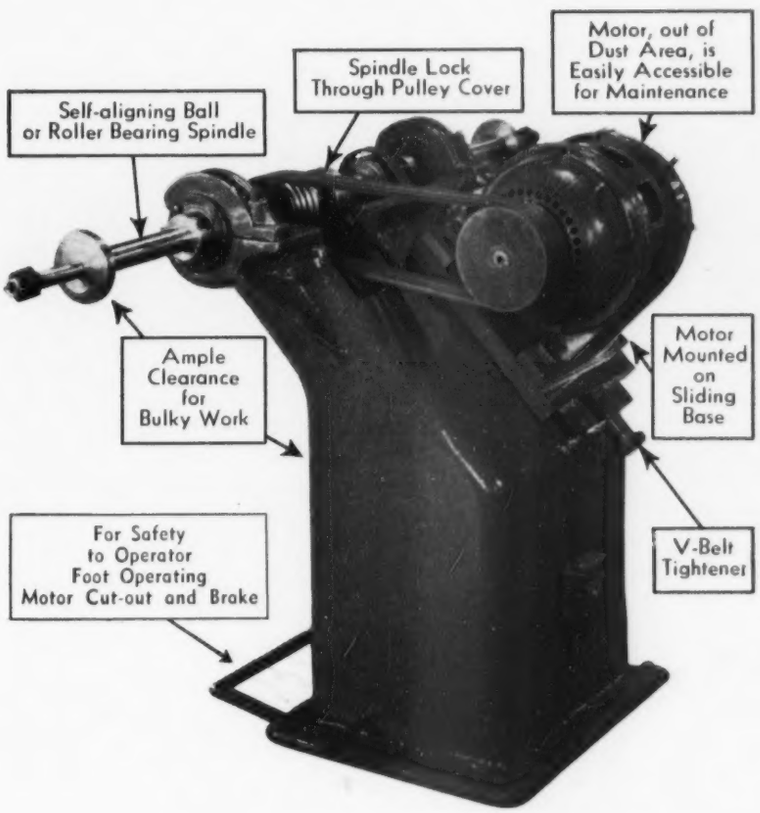
METAL FINISHING

11 W. 42ND ST. NEW YORK

For Improved Polishing and Buffing Operating Conditions

MITCHELL OVERHANGING HEAD MOTOR-DRIVEN POLISHING LATHE . . . *Selective Speed—Texrope Drive*


Motor, out of Dust Area, is Easily Accessible for Maintenance
Spindle Lock Through Pulley Cover
Self-aligning Ball or Roller Bearing Spindle
Ample Clearance for Bulky Work
Motor Mounted on Sliding Base
For Safety to Operator Foot Operating Motor Cut-out and Brake
V-Belt Tightener

There are a number of "special features" which make this Lathe a valuable piece of equipment for any polishing plant.

1. The motor is mounted near the top of the Lathe—easily accessible for maintenance and inspection, and provides the simplest method of adjusting the texrope drive. Motor is also out of the heavy dust area.

2. Overhanging head construction is perfectly balanced—due to location of the motor.

3. Standard Mitchell bearing mounting and unit spindle assembly is used . . . changing texropes requires the removal of but two nuts—which hold the entire assembly in place.

4. The cutting edge of the wheels is far out from the base—allowing ample room for the polishing and buffing of very large parts.

5. The Foot Operating Motor Cut-out and Brake—extending clear across the base and partly on each side, enables the operator to stop the machine instantly with but a light touch with his foot. This is an *important safety feature.* It decreases the chance of *serious accidents.*

6. The Lathe is extremely heavy, making it very desirable for use in connection with automatics where absence of vibration is essential.

Made in two models—Nos. 50 and 51; built on the same base. The only difference is in the size of the spindles and in the number of bearings.

We will gladly send detailed information —specifications and prices upon request.

FREDERIC B. STEVENS, INC.

DETROIT, MICHIGAN

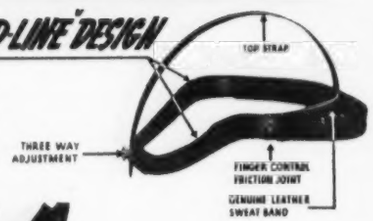
New Haven Buffalo Cleveland Indianapolis Windsor Toronto

"EVERYTHING FOR THE POLISHING AND PLATING PLANT"

FULL-FACE PROTECTION
against **LIGHT** *flying particles*
WITH A BIG PLUS IN EASY COMFORT!

Featuring the "HEAD-LINE" DESIGN

Preformed headgear fits natural contours at back of head, assuring comfort.



M·S·A FACESHIELDS

DESIGNED *to fit the Head!*
No pressure points!

In every metal-finishing job where light flying particles endanger or discomfort the worker, M.S.A. Faceshields provide protection, durability, and outstanding wearing ease. Leatherette-bound visors, .020" thick, in 4", 6", and 8" lengths, are made of highest quality cellulose acetate, perfectly transparent. Non-bound .040" and .060" visors are also available. Three-way, fully-adjustable fiber headgear is *preformed to head shape*—with top strap supporting weight of assembly, and finger-control friction adjustment of up or down visor movement. Model shown has full sparkshield; semi or no-sparkshield models are available. Write for descriptive Bulletin CE-16!

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PHYTANIUM - BLENDED

The MODERN BLACK FINISH for STEEL

Around the world — on every front — steel products of war are finished with Pentrate. Many types of weapons, steel propeller blades, engine parts, precision instruments and a multitude of other items have this protective Pentrating finish.

Designers and engineers with an eye to post war products have included Pentrate in the plans for the future.

Pentrate gives a deep black durable rust resistant finish to steel. There is an actual penetration with positively no size change. Bearing manufacturers have found the friction reducing quality of Pentrated surfaces advantageous.

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SPRINGFIELD, MASSACHUSETTS

*PATENTED

how heavy silver plating

SOLVES A WARTIME PROBLEM

★ ★ ★ HEAVY COATINGS of silver now can be readily electrodeposited by a new plating process. The deposits are considerably thicker than those which could be obtained commercially by older methods. Today, this new development—an important contribution to the production of war equipment—is in use by leading industrial and job platers.

★ ★ In obtaining this extra-heavy silver plate, du Pont Potassium Cyanide speeds the job, gives heavier coatings at higher current densities. Coatings up to 0.03″-0.05″ can be produced using current densities as high as 150 A.S.F. These coatings are adherent, fine-grained and easily machined or burnished. In replacing the usual sodium cyanide, the improved results and speed offset the higher initial cost of potassium cyanide.

★ ★ ★ Doing unusual work? Producing at wartime speeds? Du Pont Technical Service has helped many electroplaters. It is ready to help . . . wants to bring its knowledge to your present plating problems. Write: Electroplating Division, E. I. du Pont de Nemours & Company (Inc.), Wilmington, Delaware.

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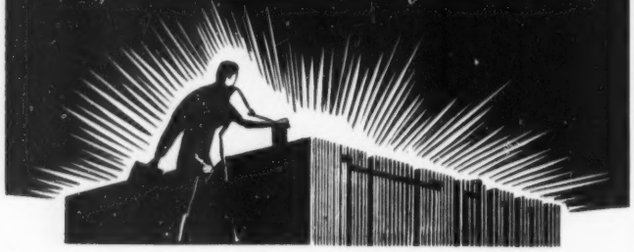
ELECTROPLATING

CHEMICALS, PROCESSES AND SERVICE

BETTER THINGS for BETTER LIVING . . . THROUGH CHEMISTRY

how TO SPEED UP WAR PRODUCTION!



Turco Products will help you speed up production by furnishing materials and methods which do a better, safer and quicker job in every department where desoiling, surface preparation or maintenance operations are handled.

In preparation for anodizing or chromatizing; for phosphatizing; for spot welding and weld-masking; for degreasing and decarbonizing of machine parts, and all of the operations listed on the coupon below, there is a thoroughly tested Turco Specialized Industrial Chemical Compound.

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- ☐ Floor Maintenance
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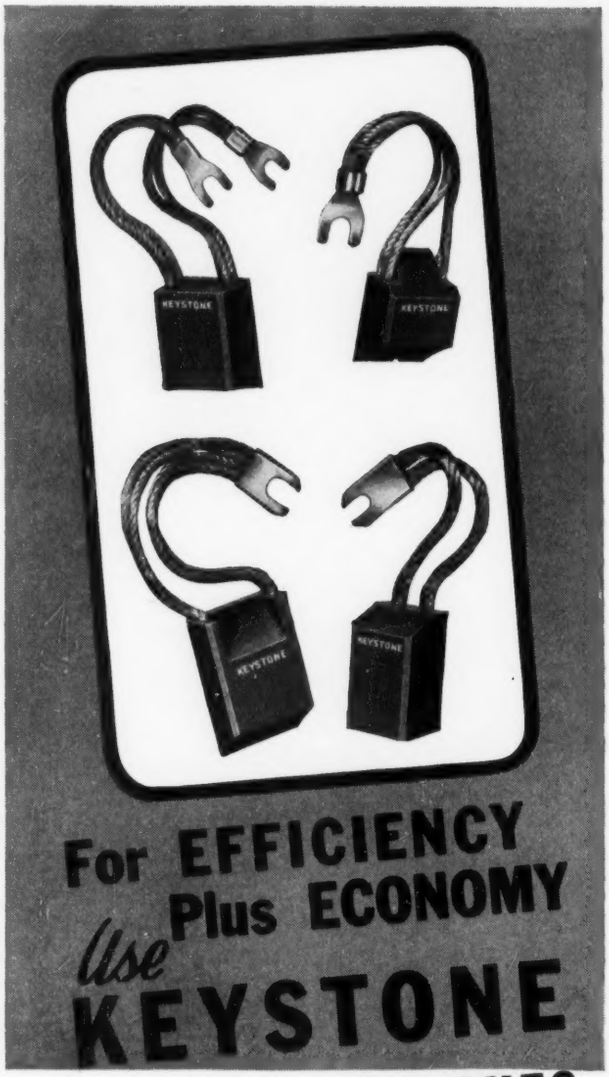

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The high current carrying capacity of Keystone Metal-Graphite Brushes assure maximum operating efficiency. They have low contact drop which minimizes current loss and their excellent lubricating qualities provide smooth running. This high efficiency and long life result in economical generator operation.

There is a Keystone Brush for all standard types of Low Voltage Generators, Contact Roll and Slip Ring applications. We will gladly recommend the type best suited for your requirements.

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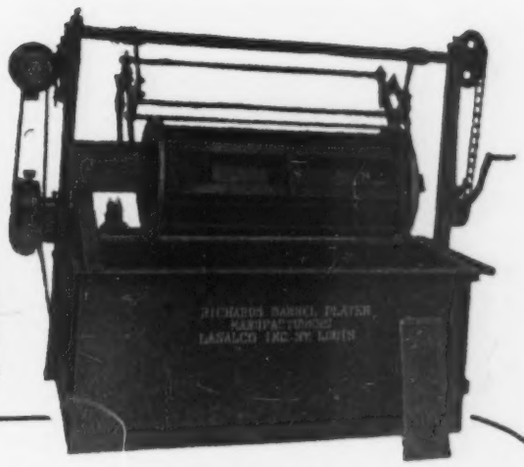
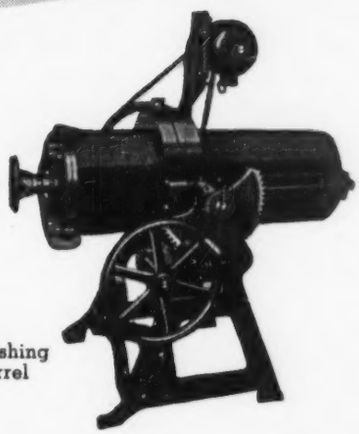
Give Your Plating and Finishing Room Problems to a LASALCO ENGINEER



Barrel Plater



Burnishing Barrel

Cushioned Belt Grinder

Here is a list of some of the equipment and supplies he has available to give you the *right* solution quickly.

Plating Barrels:
- Utility
- Bull's Eye
- Richards

Burnishing Barrels
Tumbling Barrels
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Electric Sawdust Tumblers
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Emery Cake
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Copper	Lead
Brass	Gold
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Complete Line of Chemicals and Supplies for Plating

Nickel Salts
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Write today for complete information
— or ask a Lasalco Engineer to call.

LASALCO, INC.

2818-38 LaSalle St., St. Louis, Mo.

ADVANCE SAUCER WHEEL

Reaches those "Hard to Get" places

The illustration clearly shows how the underside of a bolt head or work of a similar nature can be polished so as to retain its 90 degree angle.

The side of the wheel does not touch the shank of the bolt therefore eliminating the danger of destroying or marring the thread.

The ADVANCE SAUCER WHEEL plays an important part in the production of war material and is invaluable where tolerances must be held very close.

The illustration to the left shows an ADVANCE SAUCER WHEEL 10" Dia. x 1" Face, x 1¼" Spindle hole with a draw ½" deep . . . Wheel is flat on both sides around the hole to permit the flanges and nut to hold the wheel securely on Polishing spindle.

Made in even sizes from 8" Dia. to 16" Dia. with the draw in proportion to the Diameter.

"Tailor Made" to fit your requirements.

ADVANCE POLISHING WHEELS, INC.

844 WEST 49th PLACE — **CHICAGO, ILLINOIS**

AMINCO-BRENNER

AMINCO

MAGNE-GAGE

Measures Thickness Of Coatings on Metals

Magnetic Coatings on Non-magnetic Base Metals
Non-magnetic Coatings on Magnetic Base Metals
Nickel Coatings on Iron or Steel

Rapidly and Non-destructively

★

How You Can Profit

by using the Magne-Gage

The Magne-Gage soon pays for itself (ofttimes in a few weeks, depending on the number of measurements made), and will continue to be a profitable investment long after its initial cost will have been absorbed, because:

★ Measurements are made in a fraction of the time required by conventional methods. The time it saves gives your staff the chance for activity on other jobs.

★ It eliminates costly rejections, since it readily reveals whether or not the thickness of plating conforms to specifications.

★ Every piece tested is unharmed and ready for use or shipment.

★ It eliminates time-wasting, tedious, test procedure.

★ It eliminates the expense involved in replating or discarding specimens spoiled by destructive test methods.

★ No upkeep expense is involved in its use, and no auxiliary equipment or materials such as batteries, acids, tools, etc.

★ Its use readily suggests whether or not a re-design or rearrangement of plant equipment is necessary to produce a more nearly uniform distribution of coating. It lends itself, therefore, to increased production and a better product.

For works control or acceptance testing, you can apply the Magne-Gage method with profitable results . . . it will pay you to investigate.

RAPID . . . permits testing of a large number of specimens at low cost, with little experience.

NON-DESTRUCTIVE . . . will not injure the coating or the base metal.

UNIVERSAL . . . applicable to plane, convex or concave surfaces.

COMPACT . . . PORTABLE . . . weighs only 7½ lbs.

Write for Bulletin MF-2070

AMERICAN INSTRUMENT CO.
8010 GEORGIA AVENUE · SILVER SPRING, MARYLAND

Another KIRK & BLUM *Dust Control System meets unusual demands*

Silent operation, as well as efficiency, was demanded in this particular installation.

Here was an unusual demand and Kirk & Blum met it, using American Air Filter Co., Inc. Roto-Clones. Individual installations were made for the grinders. Hoods, specially designed for maximum flexibility and efficiency, reduced sound to a minimum.

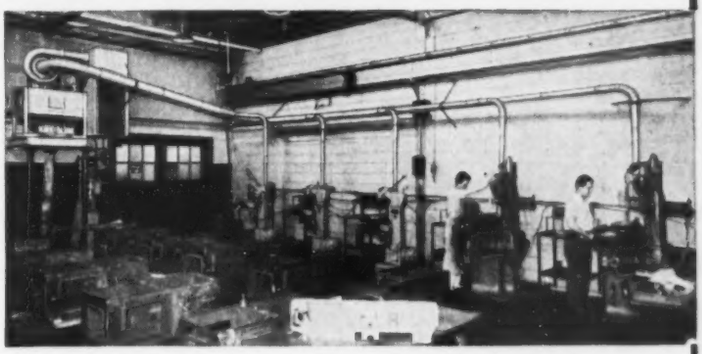

Illustration shows Kirk & Blum installation at The Sheffield Corp., Dayton, Ohio.

The air handled by each system is returned to building so it does not disturb the ideal heating and air-conditioning systems in operation.

Consult Kirk & Blum regarding your dust control and ventilating problems.

THE KIRK & BLUM MANUFACTURING CO.
AN ORGANIZATION OF ENGINEERS AND MECHANICS
2859 SPRING GROVE AVE. CINCINNATI, OHIO

Send for any of the following Booklets:

- "Dust Collecting Systems in Metal Industries"
- "Blower Systems for Woodworking Plants"
- "Fan Systems for Various Industries"
- "Industrial Ovens"
- "Cooling Systems for the Glass Industry"
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MATCHLESS
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DEFENSE! — EMERGENCY!

MEAN SPEED

To meet this emergent requirement we have developed two NEW types of POLISHING WHEELS and a NEW polishing wheel LUBRICANT.

We will be glad to arrange a test in your plant under normal working conditions.

There is no substitute for "MATCHLESS"

THE MATCHLESS METAL POLISH CO.

840 W. 49th Pl., Chicago, Ill. **726 Bloomfield Ave., Glen Ridge, N. J.**

Now that Platinum and Rhodium are out for the duration, investigate

PALLITE
TRADE MARK

The New and Perfected

PALLADIUM PLATING BATH*

PLATE with

PALLITE PALLADIUM PLATING SOLUTION

to get the brilliant Non-Tarnishing Plate.

To be applied on low carbon steel, an undercoating of silver (half-thousandths thick), must be applied before plating with PALLITE. This will be necessary to make steel rust-proof.

* Pat. Pending

PRECIMET LABORATORIES
Division of GEORGE C. LAMBROS - Refiners and Smelters
RESEARCH AND DEVELOPMENT ENGINEERS IN PRECIOUS METALS
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New War Time Restrictions on Paper

make it impossible for us to print extra copies of METAL FINISHING. This means that some of our readers who delay too long in renewing their subscription may miss out on an issue they badly want.

★ ★

Why not send in your check NOW and be sure of receiving METAL FINISHING without interruption.

TO EXECUTIVES:

NOW YOU CAN HELP

Even More...

New Treasury Ruling Permits Purchases UP TO $100,000, in any Calendar Year, of Series F and G WAR BONDS!

The Treasury's decision to increase the limitations on the F and G Bonds resulted from numerous requests by purchasers who asked the opportunity to put more money into the war program.

This is not a new Bond issue and not a new series of War Bonds. Thousands of individuals, corporations, labor unions, and other organizations have this year already purchased $50,000 of Series F and G Bonds, the old limit. Under the new regulations, however, these Bond holders will be permitted to make additional purchases of $50,000 in the remaining months of the year. The new limitation on holdings of $100,000 in any one calendar year in either Series F or G, or in both series combined, is on the cost price, not on the maturity value.

Series F and G Bonds are intended primarily for larger investors and may be registered in the names of fiduciaries, corporations, labor unions and other groups, as well as in the names of individuals.

The Series F Bond is a 12-year appreciation Bond, issued on a discount basis at 74 percent of maturity value. If held to maturity, 12 years from the date of issue, the Bond draws interest equivalent to 2.53 percent a year; computed on the purchase price, compounded semiannually.

The Series G Bond is a 12-year current income Bond issued at par, and draws interest of 2.5 percent a year, paid semiannually by Treasury check.

Don't delay—your "fighting dollars" are needed *now*. Your bank or post office has full details.

Save With . . .

War Savings Bonds

This space is a contribution to America's All-Out War Program by

METAL FINISHING

Alsop

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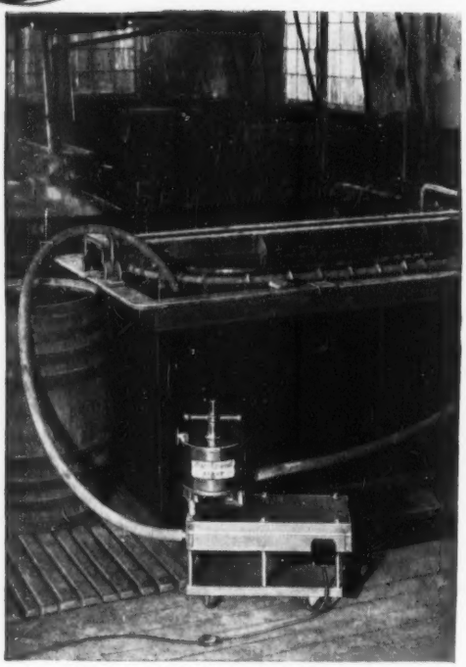


Small, compact and easy to operate. Leakproof.

One fact is proved and definite. Your plating solutions filtered by

ALSOP
"SEALED DISC" FILTERS

will produce finer finishes, less rejects, speed up your production and save you money, because they completely clean the solution, removing all trouble making dirt, dust and impurities which so easily affect the work.

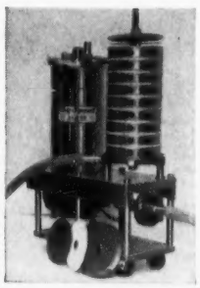
Don't take our word for it. Ask any plater or your plating supply man. They know.

These filters are good for many uses about your plant, filtering water, acids, chemicals and oils.

Easy and simple to operate. Filter discs are inexpensive and quickly renewed. All liquids are highly clarified without the loss of a drop.

Let our filtration man tell you about these "Sealed Disc" Filters. A book is available for a better understanding of filtration. Sent free on request.

Here lies the secret of "Sealed Disc" Filtration →



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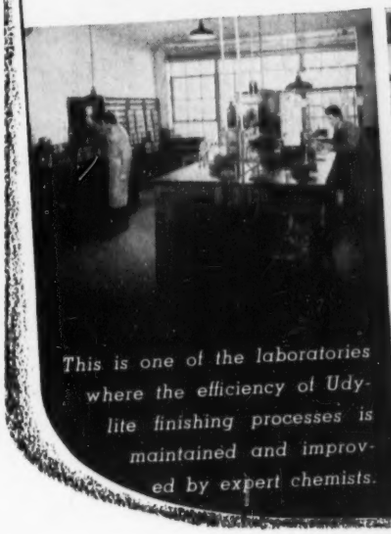
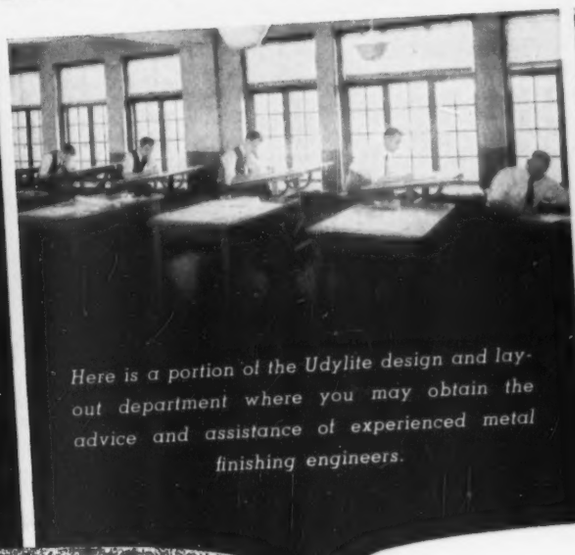
22 Bright Street **Milldale, Conn.**

UDYLITE

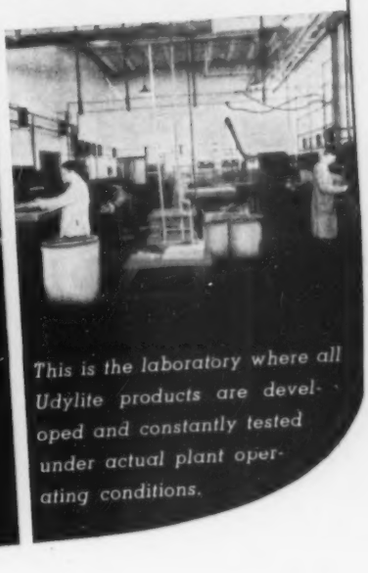
HEADQUARTERS FOR ELECTROPLATING, POLISHING AND ANODIZING INFORMATION



This is one of the laboratories where the efficiency of Udylite finishing processes is maintained and improved by expert chemists.



Here is a portion of the Udylite design and layout department where you may obtain the advice and assistance of experienced metal finishing engineers.



This is the laboratory where all Udylite products are developed and constantly tested under actual plant operating conditions.

★ ★ ★ ★

For prompt, dependable metal finishing information, call on Udylite. No organization is better equipped to give you information gained from installing plating, polishing and anodizing departments in many leading manufacturing plants throughout the country. ● **Trained plating engineers and electrochemists are** at your service. These men *know* metal finishing and they can help you plan a new installation or revise your present one for greater efficiency. They know, also, that you want information quickly. ● **Udylite has a complete line of equipment** . . . second to none in terms of quality and efficient performance. ● **and supplies** . . . for every metal finishing need. Salts, acids, anodes, buffing and polishing materials—everything required. ● Call Udylite for prompt service on your finishing requirements. You pay no more for Udylite dependability.

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For plating brass, bronze, cadmium, chromium, copper, gold, lead, nickel, silver, tin and zinc.

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  Use Harshaw Silver Cyanide and Silver Chloride for pure, dependable silver solutions.

- **ANODIZING**

  Harshaw Chromic Acid is guaranteed to meet all government and commercial specifications. . . . Immediate shipment from stock points.

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  The use of lead plating is steadily expanding — have you considered it for your products? Harshaw Lead Fluoborate, diluted with water provides a simple, economical and efficient plating bath.

Write today for literature which gives full technical information.

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Wyandotte

Announcing the consolidation of

MICHIGAN ALKALI COMPANY

THE J. B. FORD COMPANY

into

WYANDOTTE CHEMICALS CORPORATION

Back in the 1890's, two companies were established in Wyandotte, Michigan, by Captain John B. Ford, father of the plate glass industry in America, and an outstanding pioneer in the chemical industry.

The Michigan Alkali Company grew to be one of the great basic chemical companies of the world, manufacturing a wide range of products serving more than fifty different industries.

The J. B. Ford Company developed into the world's largest manufacturer of specialized cleaning materials, and an important factor in promoting sanitation and safeguarding the health of America.

The company controls warehouse facilities strategically located at approximately 200 points throughout the country.

Consolidation a Logical Step

On January 1, 1943, these companies were consolidated, still under the same family ownership, to form the Wyandotte Chemicals Corporation.

This consolidation is a logical recognition of the close relationship which has existed between the companies for many years.

Management and personnel will remain the same, but the consolidation will offer an opportunity for even greater service to our customers.

Many Benefits to Customers

Wyandotte Chemicals Corporation will continue to have one of the best distribution systems in the United States—making all Wyandotte products more readily available, to smaller as well as larger consumers.

Combining the technical staffs of the two companies will now make it possible to bring a wider range of expert technical service to Michigan Alkali and The J. B. Ford customers everywhere.

The enlarged research laboratories may be counted upon to develop important new products to meet the needs of war and post-war conditions.

And by the complete integration of the ownership of raw material sources and control of manufacturing and distribution *in the one company*, Wyandotte Chemicals Corporation will be able still further to enhance the *quality* and *value* for which Wyandotte products have long been noted.

Contracts and commitments of Michigan Alkali Company and The J. B. Ford Company in force at the end of the year 1942 will be carried out without interruption by the Wyandotte Chemicals Corporation, and customer contacts will be maintained without interruption by the Michigan Alkali Division and the J. B. Ford Division of the consolidated sales departments.

It is our sincere intention to continue to develop and manufacture to the best of our ability products which help the nation in wartime and which will contribute to a fuller life when peace is won.

WYANDOTTE CHEMICALS CORPORATION

Michigan Alkali and J. B. Ford Divisions

Wyandotte, Michigan

..*But* How Would You Fish for Molecules?

If you have unwanted grease, oil, soap, colloid molecules, and decomposition products in your plating solution—impurities that can ruin good plating jobs—you can't get them out with fish-hooks, or strain them out with a net.

But you *can* remove them with DARCO S-51!

DARCO S-51 is an activated carbon with enormous *adsorptive* surface to which such impurities adhere. When the DARCO is filtered out, out come the "molecular fish" with it.

Furthermore, DARCO S-51 permits continuous filtration—surer protection against impurities than periodic filtration—especially with today's heavy schedules.

Ten cents buys enough DARCO to keep 100 gallons of solution clean for almost a week.

Put DARCO on guard duty in your plant. Specify DARCO. Write for a sample, or get a supply from your dealer.

The article, "Physical Removal of Impurities from Plating Solutions," discusses continuous filtration in detail. Send for a copy.

DARCO—Reg. U. S. Pat. Off.

DARCO

This trademark identifies the genuine. Accept no packages without it.

DARCO

CORPORATION

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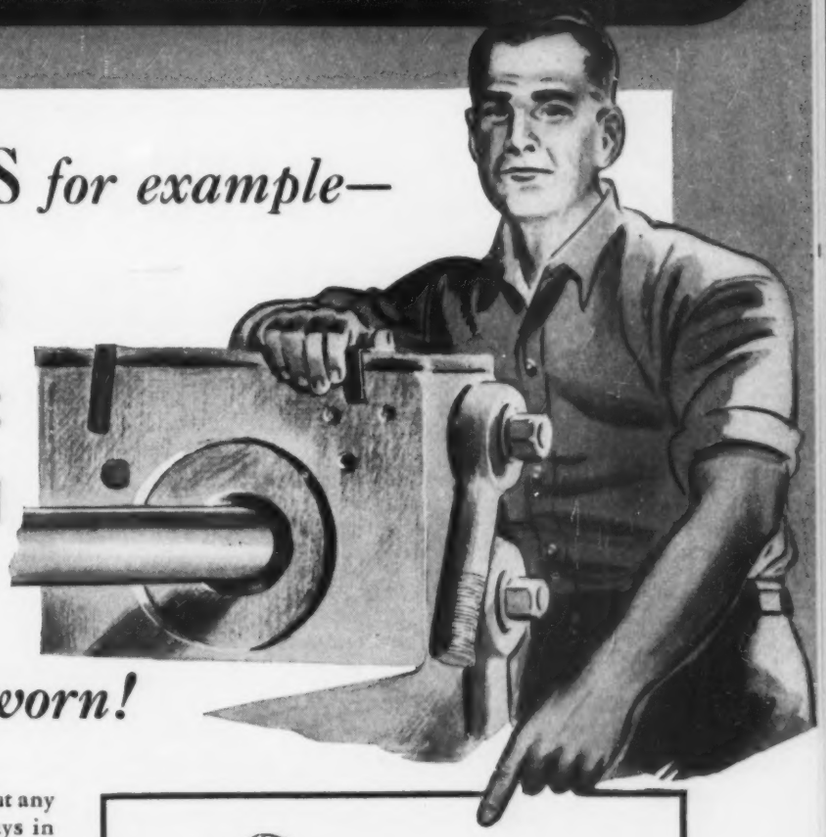

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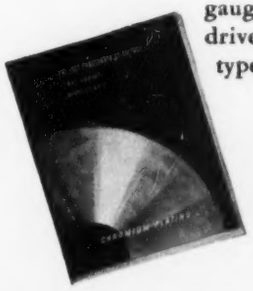

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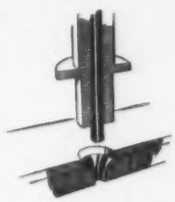

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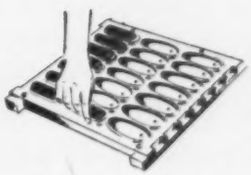

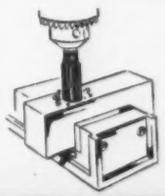

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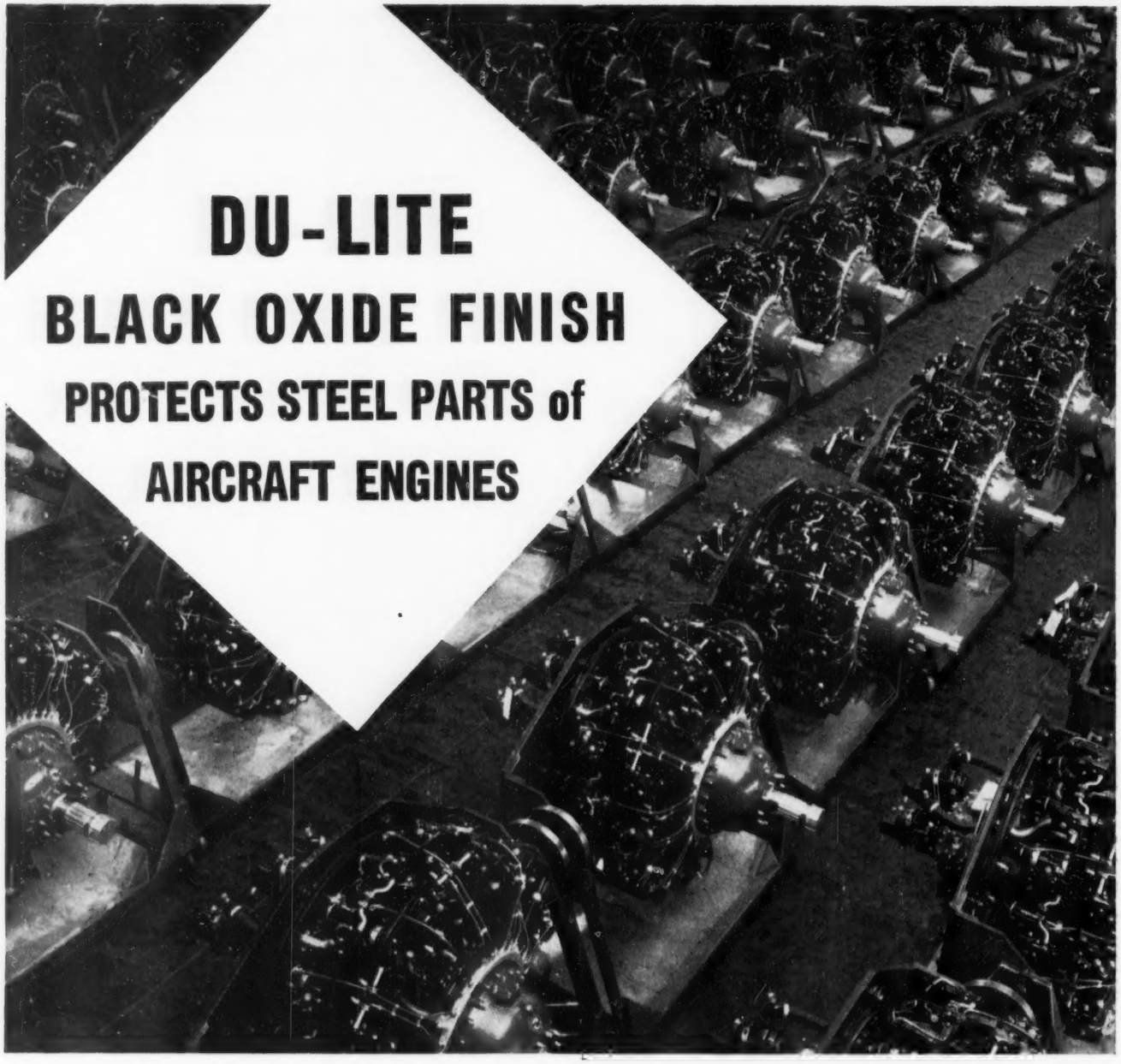

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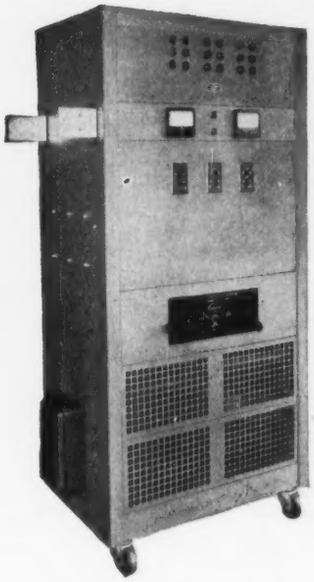

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VOL. 41, NO. 2 METAL FINISHING FEBRUARY, 1943
PREPARATION, ELECTROPLATING, COATING

PARTNERS IN BUSINESS

Uncle Sam is now the controlling partner in all metal finishing plants. He will decide how the business shall be run and will take the lion's share of the profits. His requirements will be given first consideration when determining the kind and number of employees to be hired or fired, their wages, the amount of materials to be purchased and the customers to whom the products of manufacture can be sold.

Since government control must, of necessity, be a sort of "absentee landlordism," it must be effected by correspondence, which requires a great volume of paper work. Some men resent the control and almost everyone resents the paper work, but the intelligent ones accept the inevitable and try to make the best of it.

We do not relish the receipt of a request that six copies of a special invoice be filled out and forwarded in the sum of two dollars for renewal of a war plant's subscription to *Metal Finishing* any more than the business man or finisher, hamstrung by labor shortages, enjoys the prospect of filling out purchase and inventory forms in what is facetiously referred to as his spare time.

However, consideration of the fact that firm governmental control over the nation's economy will contribute, as much as anything, to the quick and successful termination of the war, may make the burden easier to bear.

A Resume on the Electrodeposition of Aluminum

By BARNET D. OSTROW

Chemical Engineer, Benrus Watch Co.

ALUMINUM because of its position in the electrochemical series, just above the easily electrodeposited metals, has been a subject of interest from both the theoretical and the practical standpoint to many electrochemists. The numerous advantages obtained from coatings of the metal have served as an impetus for its continued investigation. The thin natural protective oxide (the thickness of which can be increased by the numerous familiar anodizing processes) endows aluminum with some excellent corrosion-resisting properties in certain atmospheres and under certain conditions. Since the metal is passive to nitric and acetic acids, is not attacked by sulphur and its oxides to any appreciable extent even at high temperatures, is not affected by numerous food acids, and under proper conditions, forms an absorptive oxide to dyes, various possible uses present themselves, some of which are as follows:

1. As a substitute for tin plate in the food canning industry.
2. As a protective coating for economizers and superheaters in steam power generating units (for protection against sulfur and its oxides).
3. As liners for cracking tanks in the petroleum industry, where possible protection against sulfur and its oxides could be offered.
4. As a cheap, colored, decorative coating formed by dyeing the oxide.
5. As a possible protective deposit on magnesium and its alloys.
6. As a probable substitute for some Alclad products.

Complete data upon the protection offered by electrodeposited aluminum against corrosion are not available. However, Blue & Mathers[22] claim that no better protection from rusting was given by electrodeposited aluminum on steel than equivalent weight of zinc, and that anodic oxidation decreased the corrosion resistance. In the latter case the anodic coating showed great porosity. It is quite probable that this decrease in protection can be directly attributed to this condition, and that dense compact oxide coatings would possibly offer better protection. Claims[6] have also been made that depositing aluminum alloys aids corrosion resistance. These alloys (0.1%Pb) are recommended for protection against certain chemical atmospheres and solutions.

The attempts to deposit the metal may be divided into four groups which will be discussed in the following order:

1. Aqueous solutions
2. Fused salts
3. Non-aqueous inorganic media
4. Organic solutions.

Aqueous Solutions

In spite of numerous attempts to deposit the metal from aqueous solutions, no successful means has as yet been obtained. The failure to deposit the metal may be attributed either to the fact that a secondary reaction occurs with the solvent (i.e. the aluminum that is formed is in a highly active state causing the following reaction:

$$Al + 3\,HOH = Al(OH)_3 + 3H^+$$

or that there is a preferential discharge of hydrogen. If the latter statement is the condition occurring, then in order to deposit aluminum from aqueous solutions it is necessary that the decomposition potential of hydrogen be increased to that of aluminum, or that the decomposition potential if aluminum be reduced to that of hydrogen, or that both be made equal.

By considering that the change in free energy of a salt in solution from that of its fused state is due to the formation of hydrates, from the free energy of hydration and the decomposition potential of its molten halide, the decomposition potential of an aqueous solution of $AlBr_3$ was obtained by Treadwell and Stern.[1] This value was calculated as 2.99 volts.

Tucker and Thomassen[2] first reported the successful deposition of the metal from aqueous solutions of the chloride and sulfate (the electrolyte being of pasty consistency). In their theoretical approach they believed that by using high speed rotating cathodes the current density could be raised to such a value that the aluminum would be deposited. In order to achieve this it was necessary to build a special rotating cathode driven by an air turbine. At 15,000 to 20,000 r.p.m. black metallic deposits were obtained, which upon buffing had the appearance of metallic aluminum. (This was further checked by qualitative tests).

Claims have been made by Q. Marino[3] for the deposition of the metal from aqueous ammoniacal solutions of the tartrate, paratartrate, or oxalate. (The aluminum is not precipitated as the hydroxide because of the probable formation of a stable organic complex). However, tests of the above by the writer gave negative results.

Although not strictly classified as an aqueous solution, a unique and interesting bath has been proposed by A. A. Khakin[4] which may be called a mixed solvent type of bath (i.e. organic and water). The anode and cathode are separated by a porous diaphragm with an aqueous aluminum salt anolyte and a catholyte containing an aluminum salt in glycerin, acetone, or other solvent.

Claims have been made by a Philadelphia company for successfully de-

positing aluminum from an aqueous solution, but no other information is known about this process.

Fused Salts

In view of the difficulties in depositing aluminum from aqueous solutions, investigations have been conducted upon fused salts. As there is no secondary reaction with solvent and no preferential discharge of hydrogen, the conditions that affect and prevent the deposition of the metal are absent. In these baths the conductance is ionic and the products are usually the same as when electrolyzed from aqueous solutions (allowance being made for the absence of water). The melting points of these baths must be lower than the melting point of the metal to be coated. Therefore, mixed salts of the alkali halides are used to depress the melting point.

In one of the first patents[5] on this subject, sheet steel was electroplated with aluminum from a bath of its fluorides (sodium and aluminum fluoride) at a temperature of 700° C. and the deposit compacted by rollers. Difficulties, such as extremely high operating temperatures and the poor adherence of the plate due to oxide formation at the interface, make this process one of historical interest only.

Subsequent investigations were with baths of lower operating temperatures (from 110° C. up to 250° C. depending on the salt mixtures used) and employed the chlorides of aluminum, sodium, and potassium, or the chlorides of sodium and aluminum alone. Baths claimed to yield well adherent deposits were patented by the Vereinigte Aluminum Werke A.G.[6] A typical composition is as follows:

$AlCl_3$	75%
NaCl	15%
KCl	10%

Recommendations are made to co-deposit a small quantity of metal electropositive to aluminum such as lead, if the deposit is for resisting chemical corrosion and also to make the work anodic for a short period in order to improve adherence. Claims were also made that these deposits were free from such impurities as iron and silicon, which are present in commercial aluminum (which is used as the anode). However, Plotnikov and Grozyianski[7] report that deposits from baths containing aluminum and sodium chlorides have impurities of sodium, iron, and silicon and that these deposits of aluminum alloy with the cathode (copper and steel used). Further work by the above authors in conjunction with Makavoi[8] was carried on and a study of optimum operating conditions reported. It is interesting to note that Czochralski and Mikalajezk[9] reported that from baths of KCl, NaCl, and $AlCl_3$ only thin deposits were adherent and that the additions of lead chloride aided in securing thicker adherent coatings. Orlava and Lanier[10] also reported that the additions of lead chloride to the NaCl-$AlCl_3$ bath improved the quality of the coating. (The similar suggestion of the Vereinigte Aluminum patents should be noted). It appears quite probable that the lead, which all the above investigators reported deposited with the aluminum, acted as an addition agent which modified the crystalline non-adherent deposits that tended to form after the initial "flash" coating.

The fused bromides of aluminum and potassium ($AlBr_3$—82% and KBr—18%) were also investigated[11] and it was reported that good deposits were obtained in a closed cell (to exclude moisture) on aluminum, magnesium, iron, brass, zinc, cadmium, copper, and lead cathodes. Best results were obtained upon a lead cathode (probably due to the diffusion and alloying of the lead cathode with the aluminum deposit). Smooth deposits were secured by superimposing alternating current (equivalent to 10% of the direct current). Cathode efficiencies were excellent (100%); however, the presence of iron caused these efficiencies to fall to as low as 50%.

Non-Aqueous Inorganic Media

Since water and liquid ammonia have similar characteristics in such properties as solvent action, dissociation of dissolved inorganic salts and the formation of ammoniates (in water hydrates) Taft and Barham[12] attempted to deposit the metal from this medium using aluminum nitrate as the metal salt. Negative results were obtained, however.

A patent[13] has been granted in which claims have been made for depositing aluminum from a bath of aluminum sulfate in anhydrous sulfuric acid (at 100° C.) containing at least 85% SO_3. If deposits are obtained, such operating difficulties as low salt solubility and employment of hot concentrated acid are highly undesirable.

Organic Baths

Some success has been obtained in depositing the metal from organic baths. For satisfactory operation of an organic bath it is desirable that the metallic salt be soluble in the solvent, that the solvent be stable upon electrolysis, that the bath have good electrical conductivity, and that the deposition potential of aluminum be attained.

The metal iron deposition potentials in an organic bath may be entirely different from those customarily found in aqueous solutions and these deposition potentials will vary depending upon the solvent. Thus it has been possible to deposit aluminum alloys of silver, copper, nickel and zinc.[24] As an illustration of the difference of deposition potentials in various solvents, an excellent example may be found in the conductivity studies of Plotnikov and Gorenbein,[27] who report that solutions of $AlCl_3$ and $AlBr_3$ with the chloride or bromide salts of K, Li, or Rb (added to increase the conductivity) in benzene gave deposits of aluminum, whereas from nitrobenzene the alkali metals were deposited.

Among the many factors that make the use of organic baths unsatisfactory, except for special purposes, are the high cost of the solution, possible toxicity and inflammability of solvent and low bath conductivity (which necessitates high operating voltages).

Driske and Briscol[14] have reported depositing traces of aluminum from ethanolamine, while negative results were obtained from acetamide, aniline, benzoyl chloride, glacial acetic acid and pyridine. Earlier unsuccessful attempts by other investigators[15] to deposit the metal from pyridine were also reported.

E. A. Lalbin[16] claimed that any solvent medium, which upon electrolysis liberated oxygen, was undesirable since the oxygen would combine with the aluminum. He therefore recommended such solvents as xylene, toluene, or acetonitriles to which was added KHF_2 (to increase the conductivity) and the metallic salt ($AlCl_3$).

Since oxygen liberation is an anodic reaction, it appears that its undesirability may be due only to the fact that reactions with the solvent may occur to yield water or that one of the decomposition products may be water.

Keyes, Swann, Klabunde, and Schicktanz[17] reported two types of baths which successfully deposited aluminum. The first, which may be called a Grignard type, since the aluminum salts, diethyl aluminum iodide and ethyl aluminum iodide, were prepared by this reaction, gave smooth adherent deposits. It is interesting to note the high voltage (40 volts) necessary to obtain the desired operating c.d. (0.02 amp./sq. cm.) when the electrodes were 1 cm. apart. Photomicrographs of these deposits showed a slight tendency for the aluminum to alloy with the copper cathode. In the patent issued for the above process a closed cell with an atmosphere of dry nitrogen gas is specified. In the second bath, which may be called a low melting organic complex salt type, only a partially adherent deposit was secured. The complex, tetraethyl aluminum bromide $[(C_2H_5)_4\ AlBr_4]$, which was prepared by heating $AlBr_3$ and tetraethyl ammonium bromide $[(C_2H_5)_4\text{-}(NH_4)_3Br_4]$ in a vacuum to exclude moisture, melted at 100° C. and was electrolyzed at this temperature. The voltage required for this bath was 16 volts.

Interesting data have been published in connection with the attempts to deposit aluminum from organic baths (a metal salt dissolved in an organic liquid). For the sake of brevity and because of the possible interest in the various solvents and compounds tried, a brief resume will be given. Aluminum acetate in such solvents as benzyl alcohol, acetone, acetanhydrin, furfural, methyl alcohol, isobutyl alcohol, amyl alcohol, and nitrobenzene passed no current at 110 volts. None of the salts tried dissolved in diethyl sulfate (an excellent dissociating medium if the salts were soluble). Aluminum Grignards made from benzene and aluminum chloride gave no deposits, while those prepared from the iodides in the presence of dry ether gave a deposit.[17] Organic amine salts, such as ethyl ammonium chloride and tetraethyl ammonium chloride, were heated with aluminum chloride to form solid, low-melting aluminum complexes; electrolysis of these complexes gave no deposit. Similar results were obtained with the fluorides of the above compounds. However, use of the bromides of these compounds resulted in a mass of grey aluminum crystals.[17, 19]

In 1902 M. A. Plotnikoff[20] made the interesting discovery that aluminum bromide dissolved in ethyl bromide yielded a solution of good electrical conductivity. Further study by H. E. Patten[21] showed that non-adherent crystalline deposits were obtained on a platinum cathode from 40-95% solutions of aluminum bromide in ethyl bromide. Subsequent studies by other workers showed that the conductivity of aluminum bromide in ethyl bromide was increased by the addition of benzene and that this property increased with time. Further investigation by Blue and Mathers[22, 23] yielded baths which had excellent conductivity and gave well-adherent deposits. A typical bath and operating conditions follow:

Aluminum chloride	20 g.
Aluminum bromide	20 g.
Ethyl bromide	40 ml.
Aluminum (dissolved by the ethyl bromide)	4 g
Benzene	80 ml
Xylene	40 ml.
c.d.—1.55 amp./sq. dm. (14.4 amp./sq. ft.)	
Temperature—20° C.	

It appears probable that the products formed in the above bath are ethylated aluminum compounds, ethylated benzene, or phenyl aluminum compounds (HBr and HCl are also formed).

It is necessary to carry on all electrolysis in a closed cell to exclude moisture. Tests showed that the presence of 0.05 ml. of water (in a bath volume of 130 ml.) gave dark deposits, 0.15 ml. gave non-adherent deposits, and 0.25 ml. (approximately 0.15% water) gave no deposits. Study of addition agents showed that xylene acted as a brightener; other organic brighteners tried gave poor results. New baths required a "breaking in" period.

Attempts to deposit alloys from these types of baths were successful.[24] Alloys of silver, copper, zinc, nickel, lead, and tin were obtained with best results being secured with alloys high in aluminum. The latter condition is due to the fact that the deposition potential of each of the alloying metals in the particular solvent is close to that of aluminum. Some other interesting alloy deposits were reported[24] in investigation of the deposition of aluminum from formamide, which gave no deposits of aluminum, but deposited alloys of aluminum-iron and aluminum-zinc. These baths gave alloys containing as high as 17.65% aluminum. This condition appears similar to the deposition of nickel alloys from cyanide solutions.

Plotnikov and Dibrova[26] investigated the aluminum bromide-xylene bath and reported that additions of KCl, NaCl, or NH_4I acted as brighteners with the latter giving best results.

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Palladium And Its Plating Baths

By GEORGE C. LAMBROS[1]

PALLADIUM, although discovered by Wollaston in 1803, became available to the industry only about 1919. In the short period of twenty years it has grown steadily in importance and today because of war restrictions on white metals, such as platinum, rhodium, nickel, etc., it has become a familiar metal. Palladium is one of the few metals that is not on the critical list at present.

Ruthenium - palladium, gold - palladium and other palladium alloys as well as pure palladium are being used in the jewelry, dental, electrical and other industries, and are going to be used more extensively in the near future. Palladium plating solutions, however, had found no practical application in the industry up to recently, in spite of the fact that a number of baths had been patented in the last few years. Most of these baths are impractical and, therefore, have very little value from a commercial point of view.

Ever since the introduction of white gold and platinum into the jewelry industry, a white plating solution to cover solder and improve platinum that had discolored, and also to give the article sales appeal was greatly needed. That need was fully satisfied about ten years ago by the efforts of a great many workers in the research field with the development of rhodium plating. Silver and other basis metals were plated with rhodium, giving them ideal protection against tarnish, corrosion and wear. Platinum baths have had some degree of success. Finally a palladium bath that gives satisfactory performance has been placed on the market.[2]

Palladium is one of the six platinum-group metals and almost always is found associated with these in nature.

1. Precimet Laboratories.
2. Under trade name "FALLITE" (Precimet Laboratories, N. Y. C.).

George C. Lambros

Although platinum is acknowledged to be the most abundant of the precious metals, palladium is a close second, being half as common as platinum. It is the cheapest and next to the lightest of the group.

To a large extent palladium, as well as the other platinum metals are by-products which have become increasingly important and plentiful, primarily because of the introduction of higher standards of purity of the base metals from which they are separated, such as nickel, copper, etc. It is said that in the early days of nickel refining in the Sudbury district of Canada, small quantities of precious metals were left in the nickel, sold as pure nickel. What the accumulated values of these precious metals were, we have no way of knowing, but they must have been considerable.

In 1938, world production of all platinum metals was about 540,000 ounces, of which 308,000 or 57% was recovered as by-products of nickel, copper and gold; whereas in 1929 world production was 231,000 ounces, of which 32,000 or 17% was from by-products.

The United States, since 1936, has emerged as an important producer of platinum metals, thanks to Alaska. The average U. S. production from 1925-1934 was about 8,000 ounces annually, 80% of which was from by-products of gold and other metals. Since then and especially in 1938, the U. S. production reached 48,000 ounces. We are today producing about 10% of the world's output, with the difference that now 80% comes from placer mining and 20% from by-products. The U. S. ranks as the fourth largest producer. Canada, Russia, Colombia, U. S. and South Africa is the order.

There are no breakdown figures to show how much palladium was produced in 1938, the latest year for which the figures for world production are complete. The 540,000 ounces represents production of all six platinum group metals. A figure of 60% for platinum, 30% for palladium, and 10% for iridium, osmium, rhodium and ruthenium combined would be pretty close to being correct. On this basis, 162,000 ounces of palladium were produced in 1938. Only a part of this palladium production was consumed, it is believed, thus resulting

	At wt.	*Sp. gr.*	*Melting point*	*Price per oz.*
1) Platinum	195.2	21.4	1755° C	$ 36
2) Iridium	193.1	22.42	2380	175
3) Osmium	190.9	22.50	2700	65
4) Rhodium	102.9	12.44	1950	50
5) Palladium	106.7	12.16	1550	25
6) Ruthenium	101.7	12.1	2450	36

in yearly additions to stocks on hand. Strange as it may seem, in the earth's crust, palladium is more abundant than gold.

Of the 206,890 ounces of precious metals consumed in 1940 in the United States, palladium accounted for 69,319 ounces.

Industry	*oz.*
1) Chemical (catalyst)	1,024
2) Electrical	32,528
3) Dental	26,346
4) Jewelry	7,624
5) Miscellaneous	1,197
	69,319

Stocks of palladium on hand increased sharply at the end of 1940 to 93,244 ounces.

Physical Properties

Palladium is a silver-white metal similar to platinum. Its specific gravity, 12.16, is close to that of 14 karat gold, compared with 19.3 for gold, 21.50 for platinum and 12.44 for rhodium. An ounce of palladium will cover almost twice the surface that an ounce of platinum or gold will, for the same thickness of plate. The price of palladium being two-thirds that of platinum, makes the comparative cost of same thickness of plate, one-third that of platinum.

Palladium, like platinum, is very ductile and malleable. The Erichsen ductility test is 7.6 mm. for hard palladium and 12.0 mm. for the annealed metal. Its melting point of 1554° C. (2830° F.) is about the same as that of iron.

The hardness of native palladium on Mohs scale is said to be between 4 and 5. The Brinell hardness, 61. The Brinell hardness for cast metal is 52; for hard, 109; and for the annealed, 49. The scleroscopic hardness is 25 for hard and 8 for the annealed. Electrodeposited palladium is as hard as nickel.

On being heated in the air a bluish film of palladium suboxide forms at about 600° C. This oxide decomposes when the temperature reaches 800° C. and the metal again becomes bright.

By far the most important property of palladium is that it does not tarnish in the atmosphere. The electrodeposited palladium plate from the "Pallite" bath is brilliantly white, not the pinkish whiteness of rhodium, but a bluish white which is very pleasing and mellow.

The reflectivity of palladium is 74.8 per cent as compared with 84.0 per cent for rhodium and 96.4 per cent for silver. Other authorities place palladium at 64% against 100% for silver.

Its electrical conductivity is 14% that of silver. Like platinum, however, its resistance will decrease as the temperature is lowered.

If the thermal conductivity of silver is taken as 100, that of palladium is 6.3.

Chemical Properties

Palladium has a marked affinity for hydrogen and therefore plays a prominent role in catalytic reactions. One cc. of palladium will absorb 800 cc. of hydrogen at room temperature. Its catalytic activity is attributed by some authorities to the ease with which the metal is superficially oxidized and reduced.

Palladium is attacked by concentrated nitric acid. It is immune to atmospheric corrosion and sulfur fumes.

Palladium forms palladic and palladous compounds. Upon dissolving the metal in aqua regia, both palladous and palladic chlorides are formed. If this solution is evaporated to dryness, only palladous chloride is obtained. Since the palladic compounds are readily decomposed to palladous, the latter are the more important. The valence in most cases is 2.

Palladium Plating Setup for Small Parts Such as Jewelry.

The most important reactions of palladium are:

1. When ammonium chloride (NH_4Cl) is added to a solution of palladous chloride, it does not precipitate palladium. This difference in reaction from platinum is employed as a method of separation.

2. If ammonium hydroxide is added to a solution of palladous chloride, a flesh colored precipitate is formed, which is soluble in excess ammonia. From this solution the very characteristic compound $Pd(NH_3)_2Cl_2$ is precipitated with hydrochloric acid.

3. It forms the only insoluble cyanide of the precious metal group. When $Hg(CN)_2$ is added to palladous chloride $Pd(CN)_2$ is formed.

Applications

Of the 70,000 ounces of palladium consumed in the U. S. in 1940, about one-half was used for electrical contacts and other electrical devices where the contact pressure and currents are very low, such as found in telegraph relays. The main requirements here are resistance to corrosion and abrasion and the necessity of withstanding a high arcing current.

About 40% was used in dentistry in 1940. This important application is the best proof we have as to palladium's inertness and non-poisonous character.

The remaining 10% was used in chemical, in jewelry and in other industries, which, today would include electroplating.

For some years palladium foil has been used for the decoration of leather book covers, and other goods in place of silver, since the latter tarnishes. Aluminum, however, enters in competition here.

There are numerous palladium alloys many of which are in daily use. There are alloys with copper, silver, gold, nickel, cobalt, rhodium, iron, etc. Palladium's affinity for these metals is an important asset for palladium electroplating.

The use of palladium in electroplating will increase especially now during the war where it is already substituting for many white metals.

Palladium is used as a catalyst, although nickel and other metals are cheaper and have been used in its place. Palladium has been used for electrodes in the electrolysis of certain solutions and as a lining for reaction vessels either in sheets or as an electrodeposited lining.

In dentistry, lightness, price and natural color when alloyed with gold and silver make it desirable. In orthodontia, palladium gives strength and flexibility to binding wire. In medicine, the chloride is used. In gas analysis, palladium is used to adsorb hydrogen from the gas sample. It then becomes relatively simple to absorb the remaining constituents in suitable solutions.

Electrochemical Behavior

Literature contains many references to the electrodeposition of palladium, but before going into that, let us consider the electrochemistry of the simple salts of palladium. In electroplating it is usually the simple salts that are stable and give good baths. The chloride and sulfate of palladium are not completely stable in aqueous solutions and hydrolysis always occurs to some extent. The hydroxides thus formed deposit as basic compounds and that means darkening of the deposit. Such basic matter forms even in acid solutions during electrolysis, and it is only from highly acid baths that palladium can be deposited from simple salts. On the other hand, palladium does form a number of stable complex salts that can be used in electroplating.

A thin sheet of copper coated on both sides with palladium, in good condition though electrodeposited before 1855, is in the Percy collection at the Science Museum in London. From what solution this coating was electrodeposited, it is not stated or known.

It is interesting to note that in the same museum a sample of palladium plating done in 1932 does not appear to be as satisfactory as the older sample. Apparently the art of palladium plating did not progress very much in almost 100 years.

In 1883 Pilet was granted a French patent for the electrodeposition of platinum and, in 1884 he was given a U. S. patent (No. 330,149) on a palladium bath corresponding to his platinum bath. This bath is the oldest and the best known.

Palladium Plating Installation for Quantity Production, Designed for Use with Racks.

The formula given in Pfanhauser's book on electrochemistry and known as Pfanhauser's bath is similar to that of Pilet's.

	Pilet Bath	
Palladous chloride	$PdCl_2 \cdot 2H_2O$	3.7 g./L
Disodium phosphate	$Na_2HPO_4 \cdot 12H_2O$	100 "
Benzoic acid	C_6H_5COOH	2.5 "
Diammonium phosphate	$(NH_4)_2HPO_4 \cdot 12H_2O$	20 "

This bath contains only about 1.87 grams of palladium metal per liter, and can therefore be used only for flashing. The formula, as it stands, does not give satisfactory deposits. The ingredients of the bath are boiled together until the reddish brown color of the palladous chloride ($PdCl_2$) changes to a light yellow. This indicates that a complex compound of palladium ammino nature has formed, and it is ready for electroplating. The voltage required is 1-2 volts, the current density, 2-3 amp./sq. ft., and the temperature about 50° C.

To replenish the bath, palladous chloride is added and boiled again to change it to the ammino complex. This, however, introduces excess chlorides into the bath which, after a while, darken the deposit.

To avoid accumulation of the chlorides, Keitel & Zschiegner have improved the bath by substituting the palladium ammino nitrite $Pd(NH_3)_2(NO_2)_2$ instead of palladous chloride ($PdCl_2 \cdot 2H_2O$).

In the K. & Z. bath, however, the nitrite ions increase in concentration due to addition of $Pd(NH_3)_2(NO_2)_2$ when replenishing the bath. But any large increase in nitrite ions will tend to decrease the concentration of the palladium complex, therefore reducing the palladium ions that can be plated at the cathode. In time this trend might reach the point when palladium would stop plating out entirely. Such has been the case many times. Additions of NH_4NO_3 are then made and vigorous boiling will reduce the excess NO_2 and restore the bath to plating condition.

The disadvantage here of low current densities is considerable, both from the time element as well as the danger of dark deposits if the current density reaches the gassing point. Also if the pH is not watched carefully and kept above 7 by additions of ammonium hydroxide, the deposit will peel.

(Concluded on page 76)

(*Concluded from page 75*)

Cyanide baths are entirely unsatisfactory. Palladium iodide in aqueous solutions of potassium iodide gives fairly good deposits. Since silver also plates out from an iodide bath, it is possible to codeposit palladium-silver alloys of any proportions desired.

And now finally the patented "Pallite" palladium plating bath. This bath is new and different. It is a very alkaline bath. It is not very critical as to palladium metal concentration, alkalinity, or current density. Flash deposits can be obtained with palladium concentrations as low as one-quarter gram per liter, and as high as 13 grams per liter.

"Pallite" comes in concentrated solution form (40 grams palladium metal content per liter). It is then diluted with water, heated to 150° F., and a voltage of about 3-4 volts is applied. The current density for flash deposits can vary from 0.1 to 0.5 amp./sq. in. (14-70 amp./sq. ft.).

This bath is suitable for electroforming, in which case the metal concentration of the bath is raised to 80-100 grams per liter, and the current density is lowered to 3-4 amp./sq. ft. Deposits of apparently any thickness can be obtained under these conditions, with a current efficiency varying from 30 to 60%. The deposit is dense and uniform and adheres firmly. It is dull grey in appearance but polishing will bring out a bright surface.

The best conditions of the flash palladium bath are as follows:

1. Palladium metal concentration: 2-3 grams per liter.
2. Temperature: 160° F.
3. Current density: 0.2 amp./sq. in. (20-30 amp./sq. ft.).
4. Voltage: about 3-4 volts.
5. Time of plating: 30-120 seconds.

To replenish the bath more of the "Pallite" solution is added.

Anodes can be of platinum or palladium. Both are insoluble.

Theoretical rate of electrodeposition for 100% current efficiency: 34 mgms. (½ grain) palladium per amp. minute.

Weight of Given Thicknesses of Palladium

Thickness	Wt. per sq. in.
0.000001"	0.0002 g.
0.00001"	0.002 g.
0.0001"	0.020 g.
0.001"	0.197 g.

Hard Chromium and the Perishable Tool Shortage

By JOHN C. BOGLE

Right at this moment we are faced with a shortage of perishable tools. Drills, reamers, taps, gauges and similar items are probably the most involved. Manufacturing facility for small tools is being taxed to the limit. Still the shortage grows. Obviously something will have to be done about it.

Fortunately there *is* something that can be done about it. It is possible to extend the life of cutting tools tremendously by a method employing hard-chromium plating. The procedure is at least ten years old, and has been improved considerably in the last few years.

Naturally, the question arises, "Why has not such a valuable procedure become universal during the decade just past?" It is the purpose of this article to explain why.

In order to make use of hard chromium in prolonging tool life, it is necessary to adjust our whole method of using tools. Instead of using a reamer or a drill until it is hopelessly worn, it is expected that the tools will be first given a light application of hard-chromium plate before being put into service, and then subsequently removed from service for retreatment before the chromium coating is worn through to the steel.

After removal from service, the tool is stripped of the remaining chromium, replated to the exact original size and put back into service. Except in unusual cases, it is not necessary to finish-grind after replating.

It can plainly be seen that the installation of such a scheme, involving the rotation of tools in and out of service, would be quite an undertaking, not because the method is at all arduous, but because it involves development of an entirely new routine of tool use.

It must be remembered, also, that the hard-chromium tool-saving method was advanced in the year of 1932, at the depth of the depression. Manufacturing organizations at that time were more concerned with getting something to machine rather than with the question of how to machine it.

Instead of today's tool shortage, there was, in those days, a glut of manufactured articles, and the shelves of stock rooms and dealers' stores were loaded with merchandise that showed a perverse tendency to remain there.

In 1932, shop executives were covering their own jobs and the jobs of other previously employed executives, as well. With little output, men were spreading their activities almost to the tearing point. Is it remarkable that a new method, involving changes in the tool-using habits of a lifetime, did not readily become popular?

Then too, you will understand that in most systems of cost accounting, small tools are written off completely just as soon as as they emerge from inventoried stores. Assuredly a saving made possible in the life of small tools would not impress the major executive except without a detailed study which he was too preoccupied to make.

So the tool-saving program never got fairly under way. Various reasons were then offered by tool users as to why a method so readily susceptible of proof as an economy measure, was not generally accepted. It was variously construed as "too complicated" or perhaps "too messy" or "too much trouble".

Maybe the best way to explain why the process was not extensively used, is to remark, simply, that it was ahead of its time. As was said at the time Billy Mitchell was vainly tearing out his heart in the interests of military aviation, "The only thing worse than being completely wrong is to be right too soon".

But now the time has arrived when hard-chromium plating, as a means of breaking the tool bottleneck, begins to justify all the hopes and aspirations of its discoverers ten years ago and those who in later years have been instrumental in improving the process. There no longer lies any choice in the matter. We shall have to plate our small cutting tools with hard-chromium. Apparently we have no other alternative.

Observations On Black Nickel

By E. SCHORE

Brooklyn, N. Y.

ARTICLES of military nature require a dark-colored finish, one that will not reflect light and at the same time will be sufficiently adherent and protective to be of practical value.

A black nickel deposit is one of the most satisfactory of all black finishes which can be produced upon metallic surfaces. It is hard and may be buffed like white nickel so that high lustre can be obtained. Its greatest value lies in the fact that it is adherent and protective and not fugitive like some other blacks produced by so-called "oxidizing" processes.

In writing this paper, it is with this one thought in mind —that these efforts may stimulate all platers to add any information they may have that will bring black nickel to the greatest possible perfection as a commercial finish. The writer is not one who professes to know all there is to know about black nickel, but rather one who is seeking knowledge and in so seeking, imparts some points which have been observed as a result of long experience and many experiments along this line.

Basis Metals for Plating

Black nickel may be deposited over any metal upon which white nickel may be deposited. Although black nickel may be deposited directly over steel and iron for this purpose, it is advisable to use a preliminary coating of copper or nickel to secure good adherence.

Since, however, neither nickel, copper nor black nickel deposits afford any appreciable protection against corrosion, the steel or iron should first be plated with zinc or cadmium to meet corrosion resistance requirements. Experiments have shown that steel plated with zinc and then with black nickel possesses about the same resistance to the salt spray test as does steel plated with the same thickness of zinc. In other words, the black nickel does not appreciably add to or detract from the protective value of the zinc coating. When black nickel is deposited over nickel, the resultant finish is more resistant to scratching or wearing than when applied to a soft metal base.

If the surface of the base metal is buffed, then the black nickel deposit will be polished. Dead surfaces likewise produce a dead black nickel. In this connection, it may be stated that the polished or buffed surface upon which the black nickel is deposited should be used whenever possible as the black nickel deposit is then jet black. Upon dead surfaces it has a gray shade or is slightly off-color. The blackest shade is obtained on polished surfaces.

Preparation of the Work

The preparation of the work for receiving the black nickel deposit is very important. Unless this preparation is carefully and thoroughly performed, the deposit will not adhere firmly. The dirt may be removed by any of the well-known methods. The surface must be chemically clean so that water will not break on it.

While the black nickel may be deposited directly upon steel, brass or copper, better results and more durable ones are produced when the black nickel is deposited upon white nickel (freshly deposited). The white nickel, in turn, adheres better when deposited upon copper. So if the best results are desired, it is preferable first to flash the work in a hot copper solution. This serves to remove any film of grease which may be present and gives a chemically clean surface for the black nickel. All that is needed is just a flash of the copper deposit; a minute or less in a good hot solution is usually all that is required. Then, the work is immediately given a white nickel deposit. This need only be a flash and when the copper is covered, no more is necessary. After rinsing, the work is ready for the black nickel bath.

The plating should be carried on upon racked or wired work whenever possible as basket work does not always give good results. Black nickel is a poor conductor and after the baskets become covered, the deposition goes on more slowly. The deposition is carried on in the usual manner practiced with other metals.

Formulas for Black Nickel Solution

The formulas which are most highly recommended and which have been used with great success are as follows:

For Still Plating

Solution No. 1

Water	1 gal.
Double nickel salts	8 oz.
Ammonium thiocyanate	2 oz.
Zinc sulphate	1 oz.

If the zinc sulphate is not in the form of glistening, white crystals but is dead white and dry, then one-half ounce should be used instead of one ounce. The water of crystallization which it contained has disappeared and it has become richer in zinc; consequently, only half the quantity is required. If desired, potassium thiocyanate may be used in place of the ammonium thiocyanate but the latter is slightly cheaper and the results obtained are the same.

Solution No. 2

Water	1 gal.
Double nickel salts	5 oz.
Ammonium thiocyanate	3 oz.
Zinc sulphate	¾ oz.

The addition of one-half ounce of sodium cyanide seems to do away with pitting.

For Barrel Plating

Solution:

Water	1 gal.
Double nickel salts	8½ oz.
Potassium thiocyanate	1 oz.
Benzoic acid	1½ oz.

The benzoic acid hardens the deposit. About 1½ ounces of nickel carbonate helps to keep the acid content down.

The double nickel salts are dissolved in water in the usual manner and then the ammonium thiocyanate is added. After this has been dissolved, the zinc sulphate is introduced.

If desired, more double nickel salts may be used in order to give a stronger solution but in this case the quantities of ammonium thiocyanate and zinc sulphate should not be changed. Little is to be gained, however, in using a solution stronger than that previously mentioned.

The solution is used at ordinary room temperatures, but in winter it must not be allowed to become colder than 60°F. and it works better if warmed to about 80°F. The deposit from this solution is not jet black but is grayish brown.

The anodes used in the black nickel solution are the regular anodes employed for nickel plating, but better results will be obtained if old instead of new ones are employed. It is better to use an anode surface several times that of the work to be plated, as the solution does not dissolve the anodes as readily as a white nickel bath. Old anodes are preferable as they dissolve more easily. If new ones are used instead of old, the solution will not work regularly for as long and will require attention sooner. Have plenty of anodes. It is a false economy to use too few, for then the solution will become acid sooner and work irregularly.

As the black nickel does not "throw" as well as white nickel, it is preferable to place the anodes on both sides of the article or around it, as the case may be, so that the current will pass evenly. This will make it possible to cover any surface evenly and uniformly. The anodes should be cleaned from time to time. Care should be taken to insure good connections.

The regulation of the current used in depositing black nickel is the most important feature of the operation, and upon it depends the success the operator will have with the process. Apply a weak current. For the production of a uniform black deposit, the potential should not exceed one volt (for still plating) and best results can be obtained with a potential of one-half to three-quarters of a volt. For barrel work three volts is the best strength to use. From the manner in which the deposit commences to form, it can readily be recognized whether or not the current is of suitable strength. The use of too strong a current will cause the deposit not only to become streaked, but also to peel off. The most frequent source of trouble is the employment of too strong a current. A current density that will give excellent results in the deposition of ordinary nickel is entirely too great for black nickel work.

Character of the Deposit

When a weak potential of from one-half to three-quarters of a volt is used, the surface of the work does not show any indications of deposit for a few seconds. It then becomes slightly yellow, next blue, and the subsequent film of deposit upon the object is iridescent and does not extend over the entire surface. Within a minute or two the iridescence disappears and the entire surface becomes black. If the surface turns black immediately, it indicates that the current being used is too great. When the black does not form at once, but the deposit passes through the yellow, blue and iridescent stages, the conditions are good and usually no difficulty will be experienced.

The deposition should be allowed to go on for an hour or more if a good heavy deposit is desired. For some classes of work, the deposition may be stopped immediately upon the formation of the desired black color, but in case it is desired to use the dip subsequently described (and it is necessary to obtain a dead black color), a heavier deposit must be had or the metal on the edges will be in danger of being attacked. The operator will have to use his own judgment concerning this part of the operation and adjust the length of time the deposition is allowed to go on to suit his own particular case.

Maintaining the Solution

The solution should be maintained in an almost neutral condition (pH 6.0-6.4 colorimetric). If it becomes acid, the deposit will be either streaked or gray. If alkaline, the deposit will be brittle and will flake off easily. As the solution is worked, it will gradually become acid because the nickel is not obtained from the anodes in sufficient quantity to compensate for that deposited. When this is the case, the deposit will become streaked and gray. Therefore if it is found that the deposit becomes streaked and gray although less than one volt is used, it indicates that the bath is acid. Among the various additions which have been proposed to maintain neutrality are ammonia and nickel carbonate. Neither is entirely satisfactory, since the addition of ammonia tends to precipitate the zinc from the solution unless great care is used and the use of nickel carbonate tends to still further increase the nickel content.

Since, however, the writer of this article is stressing the use of the dip which requires a heavy deposit, it will prove more advisable to use the nickel carbonate. If, upon analyzing the nickel content, it is decided that the nickel content is sufficient, then the addition of zinc carbonate in place of either ammonia or nickel carbonate is advised, since to the extent that it neutralizes the solution, the zinc content will be maintained. In any case, the proper neutralizing agent to be used can best be determined by an occasional analysis of the solution and the specific and special requirements necessary.

Toning the Color

The color of the black nickel, upon coming from the solution, leaves nothing to be desired. Upon standing,

however, it is apt to develop a brown shade. This brown shade frequently may be seen when the article is removed from the bath. A gray shade also often develops. This, however, disappears to a considerable extent when the work is lacquered, but even then the color is not dead black. By the use of the dip, the transformation is complete and the desirable dead black color is produced.

The dip consists of the following material:

Water	1 gal.
Iron perchloride	12 oz.
Muriatic acid	1 oz.

The iron perchloride, also known as ferric chloride, readily dissolves in water. The muriatic acid should be strong. Unless it is added, the iron perchloride will rapidly become muddy or thick although it works well at first without the addition of the acid.

This dip may be used either cold or warm. If cold, it works well but not as quickly as when heated to 120° F. It should not be heated higher than this temperature as then it is more likely to attack the deposit. If used cold, the action is fairly rapid and the results are obtained in 15-20 seconds. With the warm dip, the results are obtained almost immediately.

The black nickel deposit consists of nickel sulphide with a small quantity of zinc sulphide. It is this zinc sulphide which gives the gray or brown shade.

Black Nickel for French Gray Work

Ordinary black nickel, as used for producing a black deposit on work, is too hard for the French Gray finish as it is too hard to relieve. In order to be able to relieve it satisfactorily, a soft deposit must be used. The following formula gives a soft deposit that may be relieved easily and is suitable for all classes of French Gray work on silver.

To prepare it, proceed as follows: Take one gallon of water and dissolve in it all the sal-soda it will take up. In other words, make a saturated solution.

Take one pint of ammonia water and dissolve in it a mixture of ten parts of carbonate of nickel and one part of carbonate of copper. Just how much of this will be dissolved cannot be stated as it will depend upon the strength of the ammonia. Ammonia, as is well known, becomes weaker upon standing so it is preferable to make it in this manner. To do it properly, mix five ounces of carbonate of nickel and half ounce of carbonate of copper thoroughly and then add it, little by little, to the pint of ammonia until no more will dissolve or a saturated solution is obtained.

Now add the ammonia solution to the sal-soda solution and the bath is ready.

Use iron or steel anodes and use the solution cold. A very black deposit that is permanent and free from the fugitive nature of black nickel solutions containing arsenic, is obtained. The current strength is about that employed in regular nickel plating.

After the articles have received the black nickel deposit, they are dipped into the above-mentioned dip after having been well rinsed. The color changes to a deep black and the gray or brown shade disappears. A smell of sulphuretted hydrogen is also noticed. This is caused by the decomposition of the zinc sulphide on the surface. After the articles have been allowed to remain in the dip a sufficient time to give the deep black color, they are removed, rinsed and then dried in the customary manner. They should not be allowed to remain in the dip any longer than is necessary to give the desired shade. Otherwise the deposit may be affected.

Lacquering

All black nickel deposits should be lacquered whenever and wherever possible. While not absolutely necessary, it is conducive to better results. The black nickel is apt to turn iridescent in time and although it is true that this iridescence may be easily removed by wiping with a cloth, there are many instances in which this cannot be done, and it is in such cases that a coat of good lacquer will serve to protect it indefinitely.

A fairly heavy lacquer should be used as a thin one shows the familiar iridescent colors. It is a singular fact, undoubtedly caused by the black color of the deposit, that a thin lacquer which will not become iridescent on brass work, will show it to a considerable extent on a black nickel surface. A dip or brush lacquer can be used, as the occasion requires.

Causes of Difficulties

The production of a good black nickel deposit requires considerable care as there are many things which must be taken into careful consideration. The following notes will serve to indicate the source of the difficulties found in plating black nickel.

When the black nickel deposit has spear-shaped markings on it and is partly white, too high voltage is being used.

If the deposit flakes off after standing for some time, too strong a current has been used or the work is not clean. If the deposit is too heavy, it is also likely to flake off because of the fact that it is not a metal but principally a brittle nickel sulphide.

Should the deposit be white, it signifies that the current is too strong or the solution has become acid.

If, after removing from the dip, the deposit is still brown or gray, the dip is old or the article has not remained in the dip sufficiently long.

If, although the voltage is right (less than one volt) the deposit is streaked, the bath has become acid.

Should the edges of the deposit be removed in the dip, the dip is too hot or the black nickel was not deposited a sufficiently long time.

If, after lacquering, the surface is iridescent, this means the lacquer is too thin.

If care is taken in maintaining the right voltage and in keeping the solution neutral, no difficulty will be experienced in obtaining a good black nickel deposit.

Control of Ammonia in the Electrodeposition of Brass

By J. H. MONAWECK*

FOR many years brass has been plated on iron and steel articles to make them resemble the more expensive solid brass hardware. With this end in view, the plating industry was not interested in the composition of the brass plate but only in the color. The addition of ammonia to the plating bath was considered necessary in that the resultant deposit had a good yellow color. It was not until the advent of bonding rubber to steel by means of an intermediate brass plate that the composition of the deposited brass became critical or required close control. In the past, the common control over ammonia additions to the bath was a frequent analysis of the brass plate.

Historical

Ferguson and Sturdevant[1] disclosed the fact that ammonia additions to a brass plating bath increased the depositing potential of both copper and zinc but increased the depositing potential of the copper more than that of the zinc. They also found that the addition of 1.05 mol./L. of ammonia reduced the resultant composition of the brass plate to 57% Cu. This disclosure was an initial step in the correlation of ammonia addition to the brass bath, and the resultant brass plate.

In 1930, Hogaboom[2] reported the regular daily addition of 0.4 cc. of ammonia to a brass bath to produce a good yellow brass. This observation has particular value in that the composition of the brass plate is controlled over a period of time by a continuous addition of ammonia. Coats[3] recorded data obtained from a brass bath containing a more or less fixed concentration of 1.02 g./L. of ammonia. He investigated the effect of varying the concentration of ingredients and external conditions such as temperature and current density, on the composition of the resultant brass plate. The composition of the brass deposit was controlled by varying concentrations and external conditions rather than by the addition of the ammonia.

Pan[4] in his investigation of the brass plating bath revealed considerable information on the composition of the brass plate *vs.* the varying concentrations of ammonia. He also investigated the effect of varying the copper-zinc ratios and current densities in the brass bath. However, Pan dealt with solutions to which ammonia was added as such. No attempt was made by him to analyze and adjust the solutions over a considerable period of time. Heiman and McNabb[5] point out that the free cyanide (determination by the evolution method) will be low in the presence of ammonia.

Experimental

While all of the above investigators controlled the composition of the brass deposit either by varying external conditions or by addition of ammonia to the bath, no detailed method of analysis of the all important ammonia is given. The absence of concrete details of analysis of ammonia in a brass bath is probably due to the fact that the cyanide radical is present and apt to decompose into ammonia during analytical operations. Prescott and Johnson[6] state that "fixed alkali hydroxides in boiling solutions, strongly alkaline, gradually decompose cyanides with production of ammonia and formate: $HCN + KOH + H_2O = KCHO_2 + NH_3$." According to this equation, the simple operation of heating or boiling a sample of brass solution would generate a certain amount of ammonia, depending on the alkalinity, degree of heating, and length of time at heat. All of these complications made the true analysis more difficult.

The commonest analytical method for determining ammonia in a brass solution consists of an addition of $Ca(OH)_2$ to the sample, boiling for several minutes and collecting the ammonia in standard acid. A consideration of the above equation would indicate that this method of analysis would generate ammonia and consequently give a high result.[7] To prove this point, a brass bath was made up according to the following formula:

Copper	15.78 g./L.
Zinc	8.53 g./L.
Complex cyanide: $NaCN + Na_2Zn(CN)_4$	33.5 g./L.
Free cyanide	8.1 g./L.
NH_4OH (24.4% NH_3)	1.5 cc./L. (0.37 g./L. NH_3)

Several 10 cc. samples of this solution were analyzed according to the above method and the ammonia concentrations varied from 0.58 g./L. to 1.12 g./L. This discrepancy was found to depend on the length of time the solution was heated. If the solution was boiled for five minutes, the analysis showed around 0.5 g./L.; if boiled for a half hour, the ammonia analysis showed approximately 1.1 g./L. The excess NH_3 is undoubtedly due to the decomposition of cyanide as pointed out above and discussed below.

The next analytical method to determine NH_3 concentration in the presence of CN was a continuation of the method recommended by Coats.[3] This method consisted of two operations:

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* *Paper presented at the 82nd General Meeting of the Electrochemical Society at Detroit and reprinted herewith with the Society's permission.*

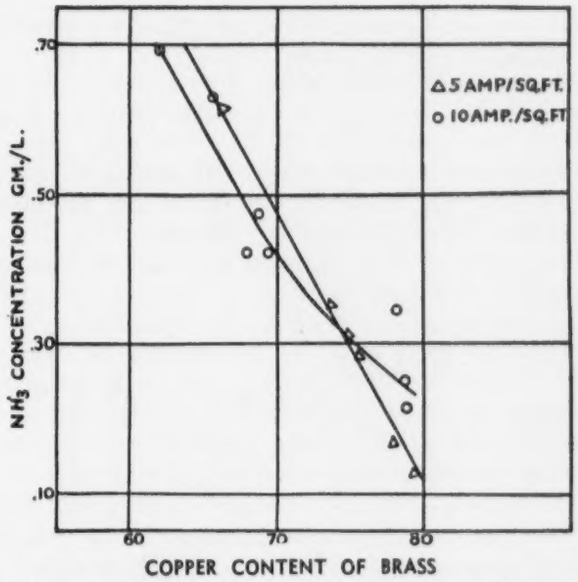

Fig. 1. Effect of Ammonia Concentration on Copper Content of Plate.

(1) Distillation of the plating bath in the presence of HCl. This treatment presumably drove off all of the cyanide as HCN, which distilled over and was then collected in a caustic soda solution. An aliquot part of the caustic solution was titrated with $AgNO_3$ and NaI in the usual manner.

(2) The solution remaining behind was then made alkaline with NaOH and the distillation continued. The distillate containing the ammonia was collected in standard acid and the excess standard acid titrated with standard alkali.

Samples of the plating solution, analyzed by distilling cyanide into NaOH in the above manner, showed a free cyanide content of 6.9 to 7.5 g./L. (0.92 to 1.0 oz./gal.) when the regular cyanide analysis with $AgNO_3$, NaOH, and NaI before distillation showed a free cyanide content of 9.2 g./L. (1.22 oz./gal.). The ammonia content from the same samples analyzed 0.46 to 0.84 g./L Every one of 12 samples analyzed showed too little free cyanide, and 11 of the samples showed an ammonia content greater than 0.5 g./L.

The above method of analysis seemed to indicate that during the heating operation to drive off the HCN, some of the cyanide was decomposing into ammonia even in the presence of HCl. This behavior seems a flat contradiction of the equation $HCN + KOH + H_2O = KCHO_2 + NH_3$ which requires an alkaline solution to produce ammonia from the cyanide radical. However, the change of the cyanide radical into ammonia can be accounted for in the following way:

When HCl is added to the sample of plating solution, a white precipitate is formed which does not entirely dissolve until after the acidified solution has distilled for some time within the kjeldahl flask. This insoluble precipitate is probably a mixture of $Na_2Cu(CN)_3$, $NaCu(CN)_2$ and CuCN, which conceivably can furnish both an alkaline condition and the CN radical *within* the precipitate. Thus, even though the surrounding major portion of the solution is acidic, the solution within the precipitated cyanides is still alkaline and the cyanide radical is capable of conversion to NH_3 under these conditions.

In order to prevent the precipitates of $NaCu(CN)_2$ and CuCN from decomposing during distillation, filtering the precipitates from the solution before distillation was tried. It had previously been noted that, when the brass solution in the kjeldahl flask was acidified with H_2SO_4 rather than with HCl, the mixed precipitate of $NaCu(CN)_2$ and CuCN did not dissolve during the distillation process, whereas the precipitate finally dissolved when the plating solution was acidified with HCl. This observation led to the belief that a brass plating solution acidified with H_2SO_4 and the precipitate filtered off before distillation might give an analysis free from the conversion of CN to NH_3.

The most successful and final method of analysis to which we resorted depended on the above assumption. It was carried out as follows:

(1) Pipette a 10 cc. sample of the brass solution into an erlenmeyer flask.
(2) Add 25 cc. distilled water.
(3) Add 25 cc. of cold 1 to 4 H_2SO_4.
(4) Filter off precipitate.
(5) Wash precipitate with 50 cc. water.
(6) Evaporate filtrate until SO_3 fumes begin to appear.
(7) Cool and dilute to 250 cc.
(8) Add a few drops of phenolphthalein.
(9) Add $Ca(OH)_2$, solid, until slurry turns pink.
(10) Distill for ½ hour in kjeldahl apparatus, collecting the NH_3 distillate in standard acid.
(11) Titrate excess acid.

The first nine analyses carried out on the brass solution detailed above gave the following NH_3 contents: 0.44 g./L.; 0.50 g./L.; 0.46 g./L.; 0.48 g./L.; 0.46 g./L.; 0.45 g./L.; 0.46 g./L.; average 0.46 g./L. These results were considered enough of a check to prove the value of the analysis.

A new brass solution was made up to analyze as follows: copper, 15.04 g./L.; zinc, 7.93 g./L.; Cu: Zn ratio, 1.9; $NaCN + Na_2Zn(CN)_4$, 31.35 g./L.; free CN, 7.6 g./L.; pH, 10.7.

The temperature was held at 28° C. (83° F.), and the operating current density was 5 amp./sq. ft. (0.54 amp./dm.²).

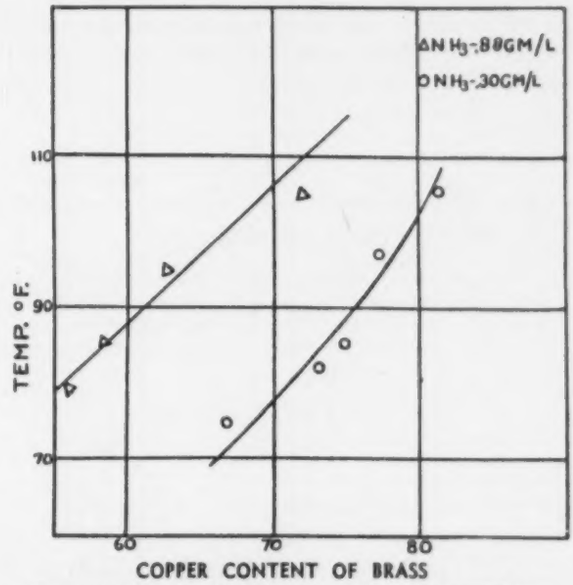

Fig. 2. Effect of Bath Temperature on Plate Composition.

The NH_3 content of the bath was varied and analyzed at irregular intervals. Brass plates capable of being stripped and analyzed were deposited at the various NH_3 concentrations. The data given in Table I were taken.

TABLE I

Effect of Ammonia Concentration on Copper Content of Plate

NH_3 Concentration	Cu in Plate
0.127 g./L.	79.9%
0.170	78.7
0.289	76.0
0.306	75.0
0.328	73.8
0.621	66.7

The data of Table I are plotted in Fig. 1. It will be noted that there is almost a straight-line relation.

Another set of data was taken in the same solution, but the current density was 10 amp./sq. ft. (1.08 amp./dm.^{2}) instead of 5 amp./sq. ft. as above. These data are shown in Table II and are likewise plotted in Fig. 1.

TABLE II

Effect of Ammonia Concentration on Copper Content of Plate

NH_3 Concentration	Cu in Plate
0.212 g./L.	79.7%
0.246	79.8
0.348	79.4
0.425	67.9
0.425	69.8
0.475	68.8
0.638	66.2
0.698	62.3

It can be seen from Fig. 1 that at 10 amp./sq. ft. there is no longer a straight-line relation. However, in the practical range of plate composition the higher current density, 10 amp./sq. ft., deposits brass of about 2% less copper for a given NH_3 composition.

Effect of Temperature

It was also important to know the effect of temperature on the composition of the resultant brass plate. The same solution as above was set at two definite NH_3 concentrations and strip plates were made at 5 amp./sq. ft. (0.54 amp./dm.^{2}) and at various temperatures. The data are shown in Table III and Fig. 2.

TABLE III

Effect of Bath Temperature on Plate Composition

Temperature		Cu in Plate
NH_3 Conc. 0.88 g./L.		
79° F.	26° C.	56.4%
85	30	58.5
95	35	62.8
105	41	70.7
NH_3 Conc. 0.30 g./L.		
75° F.	24° C.	66.6%
82	28	73.2
85	30	75.0
96	36	77.4
105	41	81.3

Roughly speaking, the per cent of copper in the deposited plate increases by about 0.5% per degree Fahrenheit rise in temperature of the plating solution.

Further study of the effect of ammonia in the brass plating bath has revealed the fact that there was a spontaneous decomposition of CN into NH_3 when new brass solutions were made up. The initial amount of ammonia formed depended apparently on external heat and the heat of solution during mixing of the chemicals.

The plating solutions discussed above as well as the three solutions below were made up as concentrated solutions by adding the copper cyanide, zinc cyanide, and sodium cyanide to 2 L. of water and then heating the mixture to 130° F. (54° C.) until solution was accomplished. The solutions were then each diluted to 4 L. The initial NH_3 concentrations of the diluted solutions were determined analytically and found to be: Soln. #1, 0.153 g./L.; Soln. #2, 0.161 g./L.; Soln. #3, 0.135 g./L.; average, 0.150 g./L.

After electrolyzing solution #2 for six hours at an accidental temperature of 95° F. (35° C.), the ammonia content analyzed 0.305 g./L. After electrolyzing solution #3 for 15 hours at 83° F. (28° C.), the ammonia content increased to 0.212 g./L.; further electrolyzing of the solution did not increase the ammonia concentration.

The above data indicate that a small percentage of ammonia was generated by the simple mixing of the chemicals necessary to make a new brass solution. Electrolyzing the solution, after analyzing the initial solution, also generated ammonia. The amount of ammonia generated apparently depended on the temperature of the solution during mixing and subsequent electrolysis. On continued use of the brass solution at 83° F. (28° C.) the ammonia concentration seemed to reach an equilibrium value of approximately 0.21 g./L. Thus, in discussing the effect of ammonia additions in a brass solution, allowance must be made for ammonia generated within the solution. It is also probable that there is a small percentage of ammonia present in a regular cyanide copper bath.

Summary

The experiments detailed above indicate the following:

1. Boiling a mixture of brass solution and HCl generates a small amount of ammonia from the cyanide. When the resulting solution is made alkaline, this ammonia distills over with the ammonia in the bath, thus giving a high analytical result.

2. Acidifying the brass solution with H_2SO_4, either drives off or precipitates all of the cyanide. Removing the precipitate by filtering prevents any subsequent decomposition of cyanide into ammonia.

3. A small amount of ammonia is generated upon heating together the ingredients of the brass solution.

4. The generated ammonia reaches a maximum concentration of approximately 0.21 g./L. at 83° F. (28° C.). Higher operating temperatures yield slightly higher ammonia concentrations.

1. *Ferguson and Sturdevant, Trans. Electrochem. Soc.* 38, 167 (1920).
2. *G. B. Hogaboom, Monthly Rev. Am. Electroplaters' Soc.* 17, 5 (1930).
3. *H. P. Coats, Monthly Rev. Am. Electroplaters' Soc.* 24, Jan. (1937).
4. *L. C. Pan, Trans. Electrochem. Soc.* 74, 425 (1938).
5. *Heiman and McNabb, Ind. Eng. Chem. (Anal. Ed.)* 10, 698 (1938).
6. *Prescott and Johnson, "Qualitative Analysis," p.* 608. *D. Van Nostrand Company, New York* (1933).
7. *Compare Heiman and McNabb, footnote* 5.
8. *Trans. Electrochem. Soc.* 80, 445 (1941).

THIS IS WASHINGTON

By George W. Grupp

METAL FINISHING's Washington Correspondent

Alaska Non-Ferrous Production in 1942 Secretary of the Interior Harold L. Ickes has announced that the preliminary estimates of the Geological Survey indicate that the 1942 Alaskan production of antimony, chromium, copper, lead, gold, mercury, platinum, silver, tungsten and tin had a total value of $18,356,000.

Antimony Advisory Committee Appointed The WPB has appointed an Antimony Industry Advisory Committee. This committee consists of Erwin Vogelsang, Director of the WPB Tin-Lead Division; Eugene Becher of the Metals and Thermit Company of New York City; Stanley A. Easton of the Bunker Hill and Sullivan Mining and Concentrating Company of Kellog, Idaho; R. H. Giebel of the Harshaw Chemical Company of New York City; R. M. Hardy of the Sunshine Mining Company of Yakima, Washington; V. L. Kegler of the Texas Mining and Smelting Company of Laredo, Texas; L. G. Matthews of the American Smelting & Refining Company of New York City, and Ralph L. McGean of the McGean Chemical Company of Cleveland, Ohio.

Army Procurement Regulations Amended The War Department announced on January 14, 1943 that the price sections of the Army Procurement Regulations were changed to conform with the amendments in the contract renegotiation provisions contained in the 1942 tax law. These provisions provide that contracts may be exempted from compulsory renegotiation if such contracts contain paragraphs which will prevent excessive profits. Prices may now be fixed for definite periods. The amended regulations also provide for fair adjustments in price and time of performance of a contract when government action interrupts production and increases costs.

Automotive Equipment Must be Reported The Office of Defense Transportation has issued a reminder of importance to all metal finishing concerns which own and operate automotive equipment. They must report on ODT form CWN-3 all of their commercial motor vehicles which are idle during the last 14 days of a calendar month. These reports should be filed with the ODT within five days after the last day of the month. It is not necessary to make a report if no equipment is idle.

Carbon Tetrachloride Order Because the producers of carbon tetrachloride have limited storage facilities, because essential users of this chemical are granted ratings higher than B-2, and because, when necessary, this chemical can be regulated through the allocation of chlorine, General Preference Chlorinated Hydrocarbon Solvents Order M-41 as amended January 5, 1943, provides that throughout 1943 the manufacturers of carbon tetrachloride are permitted to sell this chemical to firms for certain non-essential civilian uses provided they have B-2 ratings, and that all war and essential civilian needs have been met.

Chromium Order Amended According to Supplementary Order M-18-b as amended January 7, 1943, consumers of primary chromium such as bichromate of soda, bichromate of potash, sodium chromate and all chromium tanning compounds are no longer required to file Form PD-54 with suppliers; but they must file such reports with the WPB Chemical Division. If they consume less than 500 pounds of primary chromium chemicals in a calendar month they are not required to file Form PD-54 with the WPB.

Copper Price Control Lifted The Office of Price Administration on December 31, 1942, in Amendment No. 3 to Revised Price Schedule as amended, relieved the Metals Reserve Company from price control in the importation of copper scrap and copper alloy scrap.

Copper Restrictions In order to conserve scarce metal, Conservation Order M-9-c as amended December 26, 1942, prohibits the use of copper in the making of hundreds of articles such as ambulance hardware; decorative hardware; gravel stops and snow guards; gutters; ornamental metal work; plumbing and heating equipment; burial vaults; memorial tablets; buckles; buttons; dress ornaments; handbag fittings; andirons; candle sticks; cooking and table utensils; cuspidors; furniture hardware; portable heaters; jewlery; novelties; badges; beauty parlor machines; slot, game and vending machines; sun dials; toys, and thermos jugs and bottles.

Coonley Heads New Division Howard Coonley, formerly Board Chairman of the Walworth Company and a past president of the National Association of Manufacturers, has been appointed Director of a new WPB Conservation Division which consists of over 100 technically trained specialists who serve all industry divisions and government agencies. This new division, which may be called the Resources Agency, will consist of three technical branches—(1) Conservation and Substitution, (2) Simplification, and (3) Specifications.

CMP Regulation No. 1. During January the War Production Board issued Controlled Materials Plan Regulations No. 1 and No. 2. CMP Regulation No. 1 defines the obligations and rights of industry under the plan. It explains in detail the general principles announced on November 2, 1942. It is a guide to the methods of applying for, receiving and making of, allotments. To eliminate paper work, it permits orders for fabricated Class A products requiring small amounts of controlled materials, such as 100 pounds of copper and copper base alloys or 20 pounds of aluminum, to be both placed and filled without the making of formal allotments for the materials used. To prevent some undesirable practices, CMP regulation No. 1 prohibits the breaking up of large orders for the sake of qualifying as "small orders". To put it briefly, CMP Regulation No. 1 deals with the general allotment procedure methods such as (1) allotments by the Requirements Committee to the Claimant Agencies, (2) allotments by Claimant Agencies to prime consumers producing Class A products, (3) allotments by Industry Divisions to producers of Class B products, (4) allotments for prime and secondary consumers, (5) advance allotments, (6) allotment numbers, (7) bills of materials, (8) applications for allotments and other information serving as a basis for allotments, (9) responsibility of statements of requirements of both primary and secondary consumers, (10) usage of allotment forms, (11) methods of allotments, (12) methods of cancelling or reducing allotments, (13) methods of assigning allotments, (14) grouping of small allotments, (15) placing of orders for Class A products requiring small quantities of controlled materials without making allotments, (16) relationship between allotments and authorized production schedules, (17) manner of authorizing production schedules, (18) methods of complying with authorized production schedules, (19) rejection of orders in excess of capacity, (20) methods of reconciliating conflicting schedules, (21) alternative procedure for simultaneous allotments, (22) placement of orders with controlled materials producers, (23) functions of controlled materials producers, (24) restrictions on the uses of allotments or materials or products obtained by allotments, (25) adjustments of controlled materials or Class A products obtained without the use of allotments, (26) adjustments for changes in requirements, (27) required records and reports, and (28) methods of making appeals and applications for relief.

CMP Regulation No. 2 The purpose of CMP Regulation No. 2 is to hold the aluminum, copper and steel inventories of manufacturers and others to a maximum of 60 days' advance requirements. This regulation prohibits the acceptance of deliveries of controlled materials after April 1, 1943 beyond the 60-day advance requirements. However, the regulation grants the Director of General Operation the power to either shorten or lengthen this 60 day period "for any specified person or class of persons."

Dow Chemical Reduces Prices Substantial savings will accrue to the government in the construction cost of airplanes because the Dow Chemical Company has reduced its base price of 22½ cents a pound for virgin magnesium to 20½ cents a pound on January 8, 1943. The OPA did not commit itself on the amounts, but it did announce that the Dow Chemical Company has also reduced its prices on magnesium castings, aircraft sub-assemblies, and magnesium melting fluxes and protective agents.

Electric Motor Order Amended Under the terms of Conservation Order L-221 as amended January 15, 1943, all purchase orders for electric motors and generators shall not be accepted by manufacturers or dealers unless they bear preference ratings of AA-5 or higher.

Electroplaters' Equipment Restricted List 12, in an order on rubber and balata, is of special interest to electroplaters. Footnote No. 2 on List 12, found on page 13 of Supplementary Order M-15-b-1 as amended December 28, 1942, provides that "no crude rubber, latex, synthetic rubber, reclaimed rubber or scrap rubber shall be used in conjunction with tanks, barrels, pails, drums, racks, fume ducts or pipe and fittings for any operation connected with the plating or anodizing of materials."

Hand Truck Conservation Urged Members of the metal finishing industry would do well to keep their hand trucks in good condition because manufacturers were told at a recent meeting of the Hand Truck Industry Advisory Committee of the WPB that they should not encourage the making of new trucks for civilian uses. They were told to inform their customers to keep their hand trucks in good repair.

Hard Facing Materials Reports Producers of such hard facing materials as chromium, cobalt, molybdenum, nickel, tungsten and vanadium, were required to file on January 15, 1943, their reports on their December, 1942 shipments and on their February, 1943 requirements. Limitation Order L-223, which restricts the use of hard facing materials for orders rated AA-5 or higher, requires these reports.

Inventory Order M-161 Amended Because of their important uses in war production, spodumene, domestic kyanite, domestic sillimanite, talc, and diatomaceous earth were put back under the inventory restrictions of Priorities Regulation No. 1 by General Inventory Order M-161, as amended January 15, 1943.

Import Control Tightened The War Production Board tightened the control of strategic materials imports in the issuance of General Imports Order M-63, as amended January 18, 1943. The amended order eliminates the exemptions in favor of importations of materials under existing contracts and tabulated in List I and II. It provides further that no person may import, without specific authorization, any of the commodities listed in the order such as graphite, linseed oil, whale oil, aluminum scrap, antimony, copper, corundum ore, glycerine, lead, mercury, oiticica oil, shellac, silver, tin, tung oil, zinc, fatty acids, fatty alcohols, and zinc dross, scrap and skimmings.

Industry Advocate Appointed To soften the complaints of businessmen and to cushion a possible Congressional investigation into the endless pouring out of questionnaires by Washington bureaucrats, the War Production Board has appointed James Clay Woodson as Industry Advocate to whom businessmen can bring their questionnaire and data report form troubles. With 120 forms which must be filled out by approximately 25,000 companies, and 132 forms which about 125,000 different business concerns must use to satisfy the great thirst for data, Mr. Woodson should be a very busy man.

Industrial Truck Tires Restricted Metal finishing firms should note that Supplementary Order M-15-g, dated January 15, 1943, places the sale and delivery of new tires for industrial power trucks under WPB control. No tires will be delivered for replacement purposes if the purchase order does not bear a rating of A-1-a or higher on a PD-1-a certificate.

Kerosene Transport Cost Subsidy Secretary of Commerce Jesse H. Jones announced on January 12, 1943 that Defense Supplies Corporation Regulation No. 1, which provides that that RFC agency make compensatory adjustments in connection with the movement of petroleum and petroleum products to the East Coast from the Middle West and South West by tank cars and other available means, will be amended to provide for the absorption of the extraordinary costs of moving kerosene shipped in drums.

Labor Shortage Aid Offered Chairman Paul V. McNutt of the War Manpower Commission is urging firms engaged in war contracts to make wider use of the agency's Apprentice and Training Service to solve their manpower shortage problem. The chairman stated that his agency has assisted an average of 1,100 firms each month since February, 1942, by organizing on-the-job short term training and apprenticeship programs.

Labor Unions Alert The labor unions are planning to put up a stiff fight against any move made to deprive them of their new found power and basic freedoms. All legislative representatives of the American Federation of Labor and of the Railroad Brotherhoods have been urged to impress upon the members of the new Congress that labor is doing its utmost to aid in the effort to double the 1942 production quotas in 1943. Because of these efforts, the labor legislative representatives have been instructed to ask members of Congress not to pass compulsory and punitive labor legislation. In addition to that, these representatives have been told to be on the lookout for legislative proposals professing patriotic objectives to hide from view their real sinister interests.

Metal Furniture Status Unaltered Officials of the Consumers Durable Goods Division of the WPB have denied that they contemplate relaxing Limitation Order No. L-13-a, dated August 5, 1942, which prohibits the manufacture of metal furniture, including safes, filing cabinets and stands for civilian consumption unless specifically authorized by the WPB.

New Status for Molybdenum and Tungsten Because secondary tungsten and molybdenum chemicals, including pigments, are now controlled by the Chemicals Division of the WPB, these materials were removed from the molybdenum and tungsten M-orders as revealed in General Preference Molybdenum Order M-110, as amended January 9, 1943, and by General Preference Tungsten Order M-29, as amended January 9, 1943.

New PRP Form Issued During January the WPB provided manufacturers operating under the Production Requirements Plan with a new report known as Form PD-25F. This form is a simplification of the old one. It may be used for a current quarter and for supplementary authorization for future quarters. Supplementary authorizations must be made in terms of additional requirements only and not, as in the past, in terms of revised total requirements.

Non-Ferrous Mills Repair Ratings Fabricated metal parts, lumber, and metals appearing on the Revised Materials List No. 1 of War Production Board Form PD-25A are to be given a rating of AA-2x, and other materials are to be given a rating of AA-5, if needed for the repair and maintenance of small copper, zinc, copper base alloy, and zinc alloy mills, according to Preference Rating Order P-134 issued on December 31, 1942, A metal mill not operating under the Production Requirements Plan and using more than $300 per quarter for repair and maintenance materials, must apply for preference ratings on Form PD-742 within 10 days after the close of calendar quarter.

Non-Ferrous Situation Easier There are indications that pressure on non-ferrous metals has relaxed. This is due, in part, to the condition that ordinance specifications are now being written to conform with the new production facilities. For example, nickel has been eased from a very critical position to one of comparative ease.

Oil Rationing Order Revised Industrial plants which use an average of 100,000 gallons or more of distillated oil per month for purposes other than heating, may now request their local War Price and Rating Board to issue their allotments on Delivery Receipts (on Form OPA-R-1125) instead of coupons, according to amendment No. 20 to Fuel Oil Rationing Order No. 11 issued on January 2, 1943, and effective January 8, 1943.

Order M-81-a Revoked Supplementary Order M-81-a, which directed the use of electrolytic tinplate and chemically treated blackplate "to the greatest extent available" in cans for specified products—products which did not require hot-tipped plate—was revoked on January 9, 1943.

Platinum Interpretation Interpretation No. 1 of General Conservation Order M-162,—the order which prohibits the processing of platinum after January 1, 1943 for jewelry and associated items,—makes it clear that the order does not include repair and sizing of jewelry where additional platinum is used.

Price Regulation Revised Among the hundreds of articles whose manufacturers' prices were fixed as of August 1, 1942, and now revised by Amendment No. 4 to Maximum Price Regulation No. 188 issued on January 13, 1943, and effective since January 18, 1943, are refractories, caustic calcined magnesite, chemical stoneware, chemical porcelain, gypsum, foundry sand, oil paints and varnishes, mechanics' tools, silver-plated flatware and hollow ware, sterling silver flatware and hollow ware, chromium, nickel and other plated ware.

Price Adjustment Order For when price adjustments are necessary to prevent or relieve, shortages and loss of essential production of WPB's Group 1, Substitute and Supply List (Materials Vital to the War Effort), which include aluminum oxide, asbestos, corundum ore, corundum grain, cryolite, graphite, iridium and other commodities, the OPA broadened price adjustment by the issuance of Amendment No. 3 to Supplementary Regulation No. 15 to the General Maximum Price Regulation. According to this amendment, the OPA may make price adjustments (1) if a shortage exists, or is threatened, of essential and listed commodities and the producer is unable to maintain or expand production at prevailing maximum prices, and (2) if the loss of a supplier's production of those commodities would force his customers to resort to higher priced sources of supply. This amendment does not, however, apply to copper, lead and zinc because these commodities are covered by specific price schedules and produced under the premium quota plan.

Price Increases Banned The Office of Price Administration ruled on January 11, 1943 that distributors, manufacturers and wholesalers of chemical products are not permitted to reduce the size of their containers in changing from tin to glass packaging without reducing their prices accordingly. On the other hand, if increased package costs arise from the change of packing material the cost must be absorbed by the producer. However, if a producer believes the increased cost is an unreasonable burden he should then ask for an OPA ruling.

Priorities Regulation No. 1 Amended Priorities Regulation No. 1, as amended December 29, 1942, provides that persons who purchased material with the assistance of preference ratings may, under certain circumstances, sell or make use of such material for purposes other than those for which it was originally bought. Such persons may redeliver the materials to the one from whom they bought it; they may use it for their own needs which justify an AA-5 or higher rating, or they may use it to fill orders bearing ratings of AA-5 or higher.

Tin Can Order Amended According to Conservation Order M-81 as amended January 13, 1943 packing can quotas, can sizes, and can materials for bodies and ends are stipulated for products as abrasives, benzol, calcium carbide, chromic acid, graphite, nitric acid, and oils and paints.

The Silver Problem Because of the shortage of, and the restrictions on the use of chromium, copper, nickel and tin, there is an increasing demand for silver for such industrial uses as solder, airplane engine bearings, brazing alloys, electrical connections, and electroplating. The Treasury is on record as advocating legislation which will permit the use of government silver for war purposes. The major obstacles to the passage of legislation permitting the leasing or selling of the Treasury's stock of silver for industrial uses are the differences over the basic concepts of the proper role of silver and the selling price. The silver champions would oppose any legislation which would reduce the importance of silver in our monetary system. Others raise the point that the metal which backs silver currency certificates could not be sold; but they believe it might be leased for non-consumptive purposes. This, some silver champions claim, would cause the value of silver certificates to depreciate because of the risk of silver losses by leasees.

Tin Order Amended The consumption of tin will be reduced about 13,500 tons in 1943 by Preference Order M-43, as amended January 9, 1943, which replaced orders M-43 and M-43-a. The new order has reduced the tin content of solder from 30 per cent to 20 per cent. The use of pig tin is permitted only where secondary tin is not available. The new order lists products in 16 different classes. The quantity and conditions under which tin may be used are specified for each class. For example, "alloys containing not more than 5 per cent of tin by weight may be manufactured and used for coating foundry chaplets. Tin in no other form may be used for such coating." The order forbids the use of tin in the making of such articles as advertising specialties, art objects, band and musical instruments, buckles, buttons, chimes and bells, jewelry, zinc galvanizing, plating and coating for decorative purposes, and toys and games.

WMP Offers to Help The War Manpower Commission announced on January 19, 1943 that holders of war contracts who need workers with certain important skills should make known their requirements to the local office of the United States Employment Service.

WPB Regional Offices' Authority Increased The War Production Board announced on January 8, 1943 that its twelve regional office directors are now authorized to approve, countersign, and issue individual preference ratings up to and including AA-1 for emergency repairs. At the same time it was announced that its 110 district offices are now permitted to grant ratings up to and including AA-2 for emergency repairs. The authority, in both cases, is confined to repairs whose materials will not exceed $500 in value.

Zinc Dust New Order All zinc dust was placed under complete allocation and use control on January 1, 1943 by General Preference Order M-11-1. Previously, under Order M-11-a, only certain percentages of zinc dust were under control. This new order prohibits the production of zinc dust under toll agreements. Applications for allocations must be made on Form PD-755 before the 15th of the month preceding the month in which delivery is to be made. Producers must make monthly reports on Form PD-758. Exceptions to the order's control are deliveries of 75 pounds or less per month.

Dictionary of Metal Finishing Chemicals

Ammonium Hydroxide: NH_4OH. Mol. wt. 35.048. Colorless liquid with pungent odor. Also known as Aqua Ammonia, Ammonia Water, Hartshorn Spirit, Ammonia, Ammonium Hydrate. Soluble in water at ordinary temperatures. Decomposes when heated to liberate ammonia gas. Grades: Technical, U. S. P., C. P., 16,° 18°. 20°, 24° and 26° Be. Containers: Bottles (1, 4 lb.; 1 gal); Carboys (95 lb.); Drums (55, 110 gal.); Tank Trucks (13,000 lb.); Tank Cars (24,000 lb.).

Ammonium Hydrosulfide: See Ammonium Sulfide.

Ammonium Iodide: NH_4I. Mol. wt. 144.96. Sp. gr. 2.56. Hygroscopic colorless or white cubic crystals. Sublimes when heated. Solubility, 154 at 0° C., 250 at 100° C. Very soluble in alcohol, acetone, ammonia. Grades: Technical, U. S. P., C. P., N. F. Containers: Bottles (1, 5 lb.); Jars (25 lb.).

Ammonium Metavanadate: NH_4VO_3. Mol. wt. 116.99. Sp. gr. 2.33. White or yellowish crystals. Decomposes when heated. Solubility, 0.52 at 15° C., 6.95 at 96° C. with decomposition. Insoluble in alcohol and concentrated ammonium chloride solutions. Grades: Technical, C. P. Containers: Bottles (1, 5 lb.). Cartons (20 lb.). Fiber drums.

Ammonium Molybdate: $(NH_4)_6Mo_7O_{24}\cdot 4H_2O$). Mol. wt. 1235.95 Sp. gr. 2.50. Fine, colorless to yellowish white monoclinic crystals. This is the commercial form which is also known as Paramolybdate. Decomposes when heated. Solubility in cold water, 40. Decomposes in hot water. Soluble in acids and alkalis. Grades: Technical, C. P. Containers: Bottles (1, 5 lb.); Boxes (1, 5, 10 lb.); Kegs (25, 50 lb.).

Ammonium Monohydrogen Phosphate: See Ammonium Phosphate-Mono.

Ammonium Muriate: See Ammonium Chloride.

Ammonium Nitrate: NH_4NO_3. Mol. wt. 80.48. Sp. gr. 1.725. M. P. 169° C. Decomposes when heated above 210° C. Solubility, 119 at 0° C., 871 at 100° C. Slightly soluble in alcohol. Grades: Technical, Purified, C. P. Containers: Bottles (1, 5 lb.); Boxes (1-50 lb.); Kegs (25, 50, 100, 125 lb.); Barrels (200, 300 lb.); Casks (550 lb.).

This is the second installment of the dictionary of chemicals which are particularly applicable to the metal finishing industry. The first installment was presented last month. This feature will continue to run regularly in *Metal Finishing* until the dictionary is complete.

Ammonium Oxalate: $(NH_4)_2C_2O_4\cdot H_2O$ Mol. wt. 142.116. Sp. gr. 1.50. Colorless, rhombic crystals. Decomposes when heated. Solubility, 2.54 at 0° C., 11.8 at 50° C. Grades: Technical, Purified, C. P., Large, small crystals. Containers and cartons: Bottles (1, 5 lb.); Boxes, Kegs (25, 50, 100 lb.); Drums (100 lb.); Barrels (225, 250 lb.).

Ammonium Palladous Chloride: See Ammonium Chloropalladite.

Ammonium Perchlorate: NH_4ClO_4. Mol. wt. 117.497. Sp. gr. 1.95. Colorless, rhombic crystals. Decomposes when heated. Solubility, 10.74 at 0° C. and 42.5 at 85° C. Slightly soluble in alcohol. Grades: Technical, C. P. Containers: Bottles (1, 5 lb.); Steel drums (100 lb.).

Ammonium Persulfate: $(NH_4)_2S_2O_8$. Mol. wt. 228.20. Sp. gr. 1.98. Colorless, monoclinic crystals. Also known as Ammonium Peroxydisulfate. Decomposes when heated. Solubility, 58.2 at 0° C. Very soluble in hot water. Grades: Technical, Purified, C. P. Containers: Bottles (1, 5 lb.); Boxes (25 lb.); Kegs (25, 50, 100 lb.); Barrels (300 lb.).

Ammonium Phosphate: See Ammonium Phosphate-Di.

Ammonium Phosphate-Di: $(NH_4)_2HPO_4$. Mol. wt. 132.07. Sp. gr. 1.619. Colorless, monoclinic crystals. Also known as Ammonium Phosphate, Secondary Ammonium Phosphate, Ammonium Diphosphate, Ammonium Monohydrogen Phosphate, Dibasic Ammonium Phosphate. Decomposes when heated. Solubility, 42.9 at 0° C., 106.0 at 70° C. Grades: Technical, C. P., Purified. Containers: Bottles, Cartons (1, 5 lb.); Drums (100 lb.); Kegs (150 lb.); Bags (200 lb.); Barrels (325, 350, 450 lb.).

Ammonium Phosphate, Diabasic: See Ammonium Phosphate-Di.

Ammonium Phosphate-Mono: $NH_4H_2PO_4$. Mol. wt. 115.4. Sp. gr. 1.803. Colorless, tetragonal crystals. Also known as Primary Ammonium Phosphate, Ammonium Dihydrogen Phosphate, Monobasic Ammonium Phosphate. Solubility, 22.7 at 0° C. and 173 at 100° C. Grades: Technical, Purified, C. P. Containers: Bottles (1, 5 lb.); Drums (100 lb.); Kegs (150 lb.); Barrels (350 lb.).

Ammonium Phosphate, Monobasic: See Ammonium Phosphate-Mono.

Ammonium Platinichloride: See Ammonium Chloroplatinate.

Ammonium Phosphate, Primary: See Ammonium Phosphate-Mono.

Ammonium Polysulfide: See Ammonium Sulfide-Dark.

Ammonium Phosphate-Secondary: See Ammonium Phosphate-Di.

Ammonium Sulfate: $(NH_4)_2SO_4$. Mol. wt. 132.14. Sp. gr. 1.77. Colorless, rhombic crystals. White and gray granules. Decomposes when heated. Solubility, 70.6 at 0° C. and 103.8 at 100° C. Grades: Technical, Purified, C. P. Containers: Bottles, Cartons (1, 5 lb.); Boxes (25 lb.); Kegs (25, 50, 100, 125 lb.); Drums (100 lb.); Bags (100, 200 lb.); Barrels (300, 350, 400 lb.).

Ammonium Sulfate-Acid: See Ammonium Bisulfate.

Ammonium Sulfide-Light: $(NH_4)_2S$. Mol. wt. 68.14. Yellow crystals. The commercial form is a yellow solution. Also known as Yellow Ammonium Sulfide, Ammonium Hydrosulfide. Easily decomposed. Soluble in water. Grades: Technical, C. P. Containers: Bottles, Tins (1, 5 lb.); Carboys (100 lb.); Iron Drums (450, 800 lb.); Tank Cars.

Ammonium Sulfide-Dark: $(NH_4)_2S_x$. Orange solution. Also known as Red Ammonium Sulfide, Ammonium Polysulfide, Ammonium Hydrosulfide. Soluble in water. Grades: Technical, C. P. Containers: Bottles, Tins (1, 5 lb.); Carboys (100 lb.); Iron Drums (800 lb.).

Ammonium Sulfocyanate: See Ammonium Thiocyanate.

Ammonium Sulfocyanide: See Ammonium Thiocyanate.

Abbreviations: At. wt. = Atomic Weight; Mol. wt. = Molecular Weight; Sp. gr. = Specific Gravity; M. P. = Melting Point; B. P. = Boiling Point; Solubility figures, where given, are parts by weight in 100 parts of water.

Ammonium Tartrate: $(NH_4)_2C_4H_4O_6$. Mol. wt. 184.52. Sp. gr. 1.601. Colorless, monoclinic crystals. Decomposes when heated. Solubility, 6.3 at 15° C. Decomposes in hot water. Slightly soluble in alcohol. Grades: Technical, Purified, C. P. Containers: Bottles (1, 5 lb.); Boxes; Barrels.

Ammonium Thiocyanate: NH_4CNS. Mol. wt. 76.118. Sp. gr. 1.305. M. P. 149.6° C. Colorless, monoclinic deliquescent crystals. Also known as Ammonium Sulfocyanate, Ammonium Sulfocyanide. Solubility, 128 at 0° C. Very soluble in hot water. Soluble in alcohol. Grades: Technical, Purified, C. P. Containers: Bottles (1, 5, 25 lb.); Jars (25 lb); Kegs (100, 110 lb.).

Amyl Acetate: $CH_3CO_2C_5H_{11}$. Mol. wt. 130.182. Sp. gr. 0.8659. B. P. 148° C. Colorless liquid having odor of pear or banana. Also known as Banana Oil, Pear Oil, Isoamyl Acetate, Amyl Acetic Ether. Very slightly soluble in water. Soluble in alcohol. Grades: Technical, Purified. Containers: Bottles (1, 5 lb.); Cans (1, 5 gal.); Drums 5, 10, 55, 110 gal.); Carloads (30,000 lb.).

Amyl Acetate-Iso: See Amyl Acetate.

Amyl Acetic Ether: See Amyl Acetate.

Anesthesia Ether: See Ether.

Antichlor: See Sodium Thiosulfate.

Antimony: Sb. At. wt. 121.76. Sp. gr. 6.22-6.68. M. P. 630.5° C. B. P. 1630-1640° C. Very brittle metal with blue-white metallic lustre. Insoluble in water. Soluble in hot, concentrated sulfuric acid, aqua regia. Grades: Technical, C. P., Lumps, Powder, Sticks. Containers: Cans (¼, 1, 5 lb.); Boxes (1, 5, 25, 50 lb.); Kegs (100 lb.); Cases (100, 225, 250 lb.); Barrels (500, 1,000 lb.).

Antimony, Butter: See Antimony Chloride.

Antimony Chloride: $SbCl_3$. Mol. wt. 228.13. Sp. gr. 3.1. M. P. 73° C. B. P. 223.5° C. Colorless, rhombic, deliquescent crystals. Also known as Antimony Trichloride, Butter of Antimony, Mineral Butter. (Butter of Antimony is a concentrated solution of $SbCl_3$.) Solubility, 601.6 at 0° C. Infinitely soluble at 80° C. Soluble in alcohol, hydrochloric acid, tartaric acid. Grades: Technical, Purified, C. P. Containers: Crystals—Bottles (1, 5 lb.); Liquid—Bottles (1, 2, 5, 7 lb.); Jugs (10, 30, 50 lb.); Carboys (130, 160 lb.).

Antimony Chloride-Basic: See Antimony Oxychloride.

Antimony Oxide-Penta: Sb_2O_5. Mol. wt. 323.52. Sp. gr. 3.78. Yellow powder. Decomposes when heated to antimony trioxide. Insoluble in water. Soluble in hydrochloric acid and caustic solutions. Grades: Technical, C. P. Containers: Bottles (1, 5 lb.); Kegs (100 lb.).

Antimony Oxide-Tri: Sb_2O_3. Mol. wt. 291.52. Sp. gr. 5.2-5.7. M. P. 656° C. White powder. Also known as White Antimony, Antimony White. Practically insoluble in water. Soluble in hydrochloric acid, alkalis, tartaric acid, acetic acid. Grades: Technical, C. P. Containers: Bottles (1, 5 lb.); Cartons (1, 5, 25 lb.); Boxes (5, 25 lb.); Kegs (100 lb.); Bags (200 lb.); Barrels (400, 500, 600, 750 lb.); Casks (500-600 lb.).

Antimony Potassium Tartrate: $KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$. Mol. wt. 333.94. Sp. gr. 2.61. Colorless, rhombic crystals. Also known as Tartar Emetic. Solubility, 5.3 at 9°C., 35.7 at 100°C. Soluble in glycerine. Grades: Technical, U. S. P., C. P. Crystals, Powder. Containers: Bottles, Cartons (1, 5 lb.); Boxes (25, 50 lb.); Kegs (100, 125, 250 lb.); Barrels (300, 500, 750 lb.).

Antimony Sulfide-Golden: Sb_2S_5. Mol. wt. 403.82. Sp. gr. 4.1. Orange yellow powder. Also known as Antimony Pentasulfuide and Antimony Sulfuret. Decomposes when heated. Insoluble in water. Soluble in alkalis and hydrochloric acid. Grades: Technical, Purified. Containers: Cartons, Bottles (1, 5 lb.); Cans (10, 50 lb.); Boxes (25 lb.); Drums (100 lb.); Barrels (350 lb.).

Antimony Sulfide-Red: Sb_2S_3. Mol. wt. 339.70. Sp. gr. 4.6. M. P. 546°C. Black or red rhombic crystals. Also known as Sulfuret of Antimony and Antimony Trisulfide. Insoluble in water. Soluble in hydrochloric acid, alkalis, ammonium and potassium sulfides. Insoluble in acetic acid. Grades: Technical. Containers: Bottles (1, 5 lb.) Cartons, Cans (10 lb.); Boxes (25 lb.); Barrels (250, 350, 500 lb.); Casks (1,000 lb.).

Antimony Sulfuret: See Antimony Sulfide.

Antimony Trichloride: See Antimony Chloride.

Antimony Trioxide: See Antimony Oxide-Tri.

Antimony Trisulfide: See Antimony Sulfide.

Antimony White: See Antimony Oxide-Tri.

Aqua Ammonia: See Ammonium Hydroxide.

Aqua Fortis: See Nitric Acid.

Aqua Regia: A mixture of hydrochloric and nitric acids. Usually 3 parts of the former to 1 part of the latter although 4 to 1 is claimed most efficient for dissolving gold. Also known as Nitrohydrochloric acid and Nitromuriatic Acid. Corrosive, fuming yellow liquid.

Arabic Gum: See Acacia Gum.

Argols: Crude potassium acid tartrate or cream of tartar. Red or white color. Also known as Wine Lees. Containers: Cartons (1, 5 lb.); Cans (10 lb.) Barrels (250, 300, 400 lb.).

Armco Iron: Proprietary name for very pure iron.

Arsenic: As. At. wt. 74.91. Sp. gr. 5.73 cryst., 3.7 amorph. Silvery, gray-black metal. Amorphous or crystalline. Sublimes when heated. Insoluble in water. Soluble in nitric acid. Grades: Technical, Pure, Lump, Powder, Crystals, C. P. resublimed. Containers: Bottles (1 lb.); Cans (1, 10, 100 lb.); Drums-lumps (200 lb.); Cases (220 lb.).

Arsenic Acid: As_2O_5. Mol. wt. 229.82. Sp. gr. 4.09. Amorphous, white powder. Also known as Arsenic Acid Oxide; Arsenic Anhydride, Arsenic Pentoxide. Decomposes when heated. Solubility, 150 at 16°C. Very soluble in hot water. Soluble in acids, alkalis and alcohol. Grades: Technical, C. P. Containers: Bottles (1, 5 lb.).

Arsenic Acid Anhydride: See Arsenic Acid.

Arsenic. Butter: See Arsenic Chloride.

(To be continued next month)

Abbreviations: At. wt. = Atomic Weight; Mol. wt. = Molecular Weight; Sp. gr. = Specific Gravity; M. P. = Melting Point; B. P. = Boiling Point; Solubility figures, where given, are parts by weight in 100 parts of water.

PLATING AND FINISHING
POLISHING — BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. The questions this month are answered by G. B. Hogaboom, Jr., and Nathaniel Hall. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Zinc Solution Unreliable

Question: Until recently, we have been cadmium plating all our war material. However, due to the shortage of cadmium, we have been compelled to use a substitute. The majority of our parts are now being zinc plated.

For some unknown reason, we are obtaining a very irregular plating. By this we mean that we will have a very bright finish for a day or so and then using the same cleaning method and, to the best of our knowledge, the same zinc bath, our plating will suddenly show up very dark. Our zinc fluid is tested regularly; therefore we cannot account for the variation.—N. R. B., Inc.

Answer: Dark deposits in zinc solutions are generally due to minute amounts of impurities. The dark color you get at intervals may therefore be due to such a condition.

If the anodes remain in the solution overnight, some zinc will be dissolved by the caustic in the solution. Any impurities which might be in the zinc will accumulate in the solution and will result in a dark deposit. The impurities that are dissolved in the solution while the anodes are working will be plated out practically as fast as they dissolve and in such a case, you would not get dark deposits. We suggest that you check this possibility by removing the anodes from the tank at night and see if you get dark deposits the following day after the anodes are put back and plating is started.

Another cause of your difficulty may be metallic dust in the air due to polishing done in the near vicinity. We advise your checking into this possibility also.

Electrochemical Society Reprints

Question: Kindly inform me where reprints of articles appearing in the Transactions of The Electrochemical Society may be obtained.—I. M. W.

Answer: To obtain reprints of technical papers presented before meetings of The Electrochemical Society, send 50c for each one desired to Dr. Colin G. Fink, Secretary, The Electrochemical Society, Columbia University, New York, N. Y.

Barrel Silver Plating

Question: I have never come across any literature dealing with barrel silver plating. Is it being done successfully? If so, does it require a special solution and equipment?

I have a large quantity of small, flat, bronze pieces to silver plate. The order calls for a plate to withstand a 40-hour salt spray test. What deposit would be required to withstand this test?—E. M.

Answer: Barrel silver plating can be done after a fashion using a solution of 1 oz./gal. silver cyanide and 6 oz./gal. sodium cyanide. However, flat pieces will probably stick together and some will fail to plate.

The thickness of deposit required will depend on the shape of the article and the porosity of the deposit. We suggest 0.0005" as a starting thickness but deposits of various thicknesses can be subjected to the salt spray test to determine the minimum requirements.

Copper Solution Breaks Down

Question: We made up a regular copper solution of copper carbonate and sodium cyanide. Having a spare, lead-lined steel tank on hand, we used it. The solution operated satisfactorily for about two months but at present, it will not plate any color at all. Do you think the lead lining of the tank has contaminated the solution? Incidentally, the solution now has a very strong odor, almost as though acid had been added.—R. A. P.

Answer: The fact that your solution does not plate would indicate that you have an excessive cyanide content, which would result in its having the very strong odor you have noticed.

The use of lead-lined tanks for cyanide solutions is not recommended since lead will tend to dissolve and contaminate the solution. We suggest that you have your solution analyzed to determine whether or not it is in proper balance. Excessive amounts of lead will result in hard brittle deposits.

Substitutes for Critical Metals

Question: Can you advise us if there are any substitute platings to be used instead of those platings which have recently been placed on the critical list? Information as to the specifications and characteristics of substitutes for cadmium, nickel, tin and chromium should be included.—V. P.

Answer: At present, the only easily available metals which are not restricted in any way are gold, chromium, lead and palladium.

Chromium by itself has very little protective value. If a corrosion resistant finish is required, it should be applied only over a previous non-porous deposit. Gold and palladium are precious metals. They have no sacrificial protective value. The coatings must be sufficiently thick to be non-porous. The cost of such deposits would, therefore, be very high.

If appearance is not an important factor, lead should be considered since it is a very suitable protective finish and is very low in cost.

Test for Thickness of Tin Plate on Copper

Question: Will you please inform us if there is a jet method for testing the thickness of tin plate on copper?—R. C. A.

Answer: A solution containing 100 g./L. of trichloracetic acid can be used in the Hull-Strausser dropping test apparatus for determining the thickness of tin by the dropping method. If operated between 70 and 90° F. with a dropping rate of 90-110 drops per minute, each second is equivalent to 0.00001" thickness.

Trichloracetic acid is a skin irritant in this concentration and operators should be warned to handle it with care.

Patent Covers Current Reversal for Etching

Question: We should esteem it a favor if you would cite for us the number of the patent covering the reversal of current for the purpose of etching in the preliminary treatment of stainless steel or "Monel" metal prior to electroplating.—Dep't of C.

Answer: In reply to your letter, our records show that the patent on the use of current reversal in a solution of nickel chloride and hydrochloric acid for plating on stainless steel is held by the Mond Nickel Company, Ltd., British Patent 503,008, issued on November 18th, 1938.

Faulty Water Supply for Hard Chromium Plating Solutions

Question: We are putting in a hard chromium tank to work over airplane parts. In looking over the water analysis of the supply here, I find that there is a high quantity of salts, among which the highest are sulfates. As you know, sulfates play an important role in chromium plating. I have been unable to find anyone in this section of the country who can tell me definitely whether or not this water can be used for making up the bath and keeping it up.

I am enclosing a copy of the water analysis.—J. W. T.

Answer: The high sulfate content of the water would not be serious as any accumulation could easily be removed with barium carbonate. However, the excessively high solids content of the water in addition to the high chloride and bicarbonate, according to the water analysis sheet forwarded with your inquiry, would probably cause trouble after a period of time.

As the easiest way out of your difficulty, we suggest that you purchase a small-capacity water softener such as is sold for domestic and household use. This device is very simple to operate and all the water to be used for making up the plating solution and replenishing the evaporation losses can be passed through it first. There are such softeners on the market which produce the equivalent of distilled water at a cost which may run as low as a tenth of a cent per gallon and which require no heat or electrical connections.

Metal Finishing Publications

Question: Can you help us out by answering the following: 1) What journals come with membership in The Electrochemical Society? 2) What organization publishes *The Monthly Review, A. E. S.?* 3) What organization publishes the *Proceedings, A. E. S.?*—I. M. W.

Answer: The Electrochemical Society publishes a news bulletin monthly during most of the year. This bulletin contains references to articles on the subject of electrochemistry which have been published in the technical literature as well as a review of current patents. Members of the Society also receive at regular intervals pre-prints of all papers which are presented at the semi-annual meetings of the Society. Bound volumes, containing both the papers presented and transcriptions of the discussions of the papers, are available to members at the rate of $1.50 per volume.

The Monthly Review is published by the American Electroplaters' Society and is sent to all members without charge. The subscription rate for non-members is $3.00 a year. If you are interested in joining this society, there is a branch in your city and we would suggest writing for details and an application form to J. P. Mays, The Carborundum Co., Niagara Falls, New York; or you can apply at one of their meetings which are held the second Friday of each month at the Hotel Statler in your city.

The American Electroplaters' Society also publishes the proceedings of its conventions which are held yearly. These proceedings include the technical papers presented and discussions. They are sent without charge to members of the A. E. S.

Function of Wetting Agents

Question: Would you be so kind as to explain the term "wetting agent" as used in your January issue on page 16. When using muriatic acid, I use water for an addition. Is that what you mean by a wetting agent?—K. T.

Answer: A wetting agent is a material which has the property of lowering the surface tension of a solution or, in other words, of decreasing the intermolecular attraction. The importance of such materials in acid dipping is that by lowering the surface tension the solution wets the surface thoroughly and allows the acid to react evenly over the whole article. This results in a smoother pickling job.

Black Oxidizing for Tin Bottle Caps

Question: We should like to have a formula for black oxidizing of used tin bottle caps. There is also a light brown finish being employed and if you can supply us with this formula as well as the black oxidizing one, we shall appreciate it.—R. P. W., Inc.

Answer: The black oxidizing used for tin bottle caps is the hot caustic-oxidizing agent solution. You can use the following formula:

Caustic soda	5 lb.
Sodium nitrate	1 "
Sodium nitrite	1 "
Water	6 "

The above makes up approximately one gallon of solution. After soaking and tumbling in hot caustic to remove the varnish, printing, tin and cork, the caps are immersed in this solution at about 285° F. for 5-10 minutes.

Many finishers doing this work are using the various proprietary blackening salts for iron and steel. We suggest that you consult the advertisers in *Metal Finishing* for further details on these products. These proprietary solutions will probably be more readily controllable.

For a brown finish, you can use a solution containing:

Caustic soda	4 lb.
Sodium nitrate	1 "
Water	7 "

Operate at the boiling point.

Reducing Silver Chloride

Question: We are wondering if you can aid us in a shop problem that is now facing us.

We do quite a bit of silver stripping and after the strip is saturated with silver, we wash and precipitate the strip to reduce it to a chloride. Heretofore, we had been using zinc to bring the strip back to a metal. However, owing to the scarcity of zinc, we are wondering if there is another method to reduce the chloride to a metal so that we may omit the use of zinc.—R. & H.

Answer: A solution to your problem is to cover the silver chloride precipitate with a solution of about five per cent sulfuric acid and put some pieces of scrap iron or steel into the container. The mixture should be stirred occasionally.

Addendum on Copper "Creeping" in Carburizing

The following letter is printed in answer to a problem which appeared in these pages two months ago.

"Gentlemen:

"In the issue of *Metal Finishing* for December, 1942, you printed a problem posed by one of your readers which related to the 'creep or migration' of copper plate during pack-carburizing.

"This is a problem with which we have had a great deal of experience and know that the phenomenon has been of somewhat common occurrence. It appears to be more or less independent of the type of copper plate used and is caused by certain impurities that are inherent in most carburizing compounds. Due to the manner in which this migration takes place there are two possible methods of preventing it.

"The phenomenon occurs at temperatures considerably lower than the carburizing temperature. In fact, the migration is practically complete at 1200° F. For this reason the migration can be prevented by bringing the work up very rapidly through the lower temperature range. In other words, given the same carburizing compound, it is possible to cause migration by packing large boxes and placing them in a cold furnace or, to prevent the migration, by packing small boxes and putting them in a hot furnace.

"Where the operator finds it impossible to use the second method described, the copper migration can be prevented by using a special carburizer in which the impurities have been eliminated or so fixed that they no longer effect the copper plate.

Yours very truly,
Paul H. Kramer, Chief Chemist,
Park Chemical Company."

Patents

Corrosion Prevention of Iron and Zinc

U. S. Pat. 2,302,510. R. R. Tanner, assignor to Parker Rust Proof Co., Nov. 17, 1942. A method of coating a surface containing one of the group consisting of iron, steel or zinc which comprises applying to the surface a film of solution containing a phosphate of the group consisting of zinc, manganese, iron and mixtures; an oxidizing agent having an oxidation potential not greater than the potential of the common bromates in a dilute phosphoric solution and an accelerator of the group consisting of soluble compounds of copper and iron and mixtures thereof, which accelerator must be lower in the electromotive series than the metal being treated, and maintaining such a film in contact with the surface until reaction of the solution with the surface produces on the surface a substantially integral coating. Also containing an inert material which will form a friable non-adherent coating when dried, such as fuller's earth.

Example:

Fuller's earth	867	parts by wt.
Zinc dihydrogen phosphate	95	" " "
Copper sulfate	21	" " "
Sodium nitrate	17	" " "

This is mixed with water to give a consistency suitable for spraying—approximately 7.75 parts of powder to a gallon of water.

Cleaning Magnesium

U. S. Pat. 2,302,939. H. K. DeLong, assignor to The Dow Chemical Co., Nov. 24, 1942. A method of removing carbonized oil containing oxide mill scale from the surfaces of rolled articles of magnesium and magnesium-base alloys which comprises subjecting the article to the action of an aqueous solution of a water-soluble organic carboxylic acid for a time sufficient to remove the scale but insufficient to permit any substantial attack on the metal.

Example: Citric or acetic acid for 0.2 — 1.0 minute at room temperature. Concentration = 5-15% by weight.

Polishing Wheel

U. S. Pat. 2,307,385. D. Braxton, Jan. 5, 1943. An improved liner for polishing wheels, grindstones and the like using threaded flanges of novel design.

Measuring Thickness of Coatings

U. S. Pat. 2,307,649. H. C. Turner & E. A. Fielding, assignors to The General Electric Co., Ltd. (England), Jan. 5, 1943. An electromagnetic instrument for determining the thickness of coatings.

Coating by Cathode Disintegration

U. S. Pat. 2,305,758. B. Berghaus & W. Burkhardt (Germany) vested in the Alien Property Custodian, Dec. 22, 1942. A method of coating metal articles by cathode disintegration within a metal housing having a cathode to be disintegrated therein insulated with respect to the housing, and the article to be coated arranged within and insulated with respect to the housing which comprises impressing a voltage across the article with the article connected as a cathode to create a glow discharge within the housing heating the article, and impressing a voltage across the housing to disintegrate particles therefrom onto the article so as to coat the same.

Plating Non-Conductors

U. S. Pat. 2,303,871. B. F. Walker, assignor to Metaplast Corp., Dec. 1, 1942. The method of metallizing the surface of an organic plastic material which comprises treating the surface with a solution of stannous chloride and hydrochloric acid to cause the same to have the characteristics suitable for metallizing, washing the surface to remove said solution and applying to said surface a solution of silver nitrate, ammonia and a reducing agent under conditions to precipitate the silver thereon to form a metallized layer, and electrodepositing metal on said layer.

Example:

Stannous chloride	360 g.
Hydrochloric acid	216 cc.
Water	4000 cc.

Immerse for from 45 seconds to one minute. Wash off and treat with the following to deposit a silver film:

A. Silver nitrate	33.3	g.
Ammonia	28	cc.
Water	16	L.
B. Formaldehyde	22	cc.
Water	16	L.

Oxidation Prevention of Iron

U. S. Pat. 2,303,869. F. B. Quinlan & L. P. Grobel, assignors to General Electric Co., Dec. 1, 1942. The process of protecting an oxidizable, solid foundation metal from oxidation which comprises spraying upon the clean surface of such metal a coating of aluminum, spraying over the aluminum a coating of a different metal having a melting point below approximately 600°C. and capable of alloying with the aluminum coating to form a composite layer that is substantially impervious to air at an elevated temperature, and causing the said aluminum to alloy at least in part with each of the said underlying and overlying metals.

Blast Cleaning

U. S. Pat. 2,306,842. V. E. Minich, assignor to The American Foundry Equipment Co., Dec. 29, 1942. An apparatus for blast cleaning using an abrasive throwing wheel and supporting tables for the work.

Corrosion Prevention of Iron

U. S. Pat. 2,301,983. R. R. Tanner, assignor to Parker Rust Proof Co., Nov. 17, 1942. A method comprising treating a metal surface to make it wet more readily, thereafter applying to the surface a solution containing as essential ingredients hexavalent chromium and pentavalent arsenic, and drying to a non-hygroscopic condition a film of the solution on the surface.

Example of first bath:

1. Cobalt nitrate	5	g.
70% Nitric acid	20	cc.
Water	2	L.
2. Nickel carbonate	3	g.
75% Phosphoric acid	10	cc.
Water	2	L.

Both of these dips are used at room temperature and the work is immersed for about 30 seconds.

Example of second bath:

1. Ammonium dichromate	4.0%
Arsenic pentoxide	4.0 "
Duponol	0.5 "
2. Zinc dichromate	1.5 "
Arsenic pentoxide	4.0 "
Duponol	0.5 "

This is allowed to dry on the work. It is claimed that a good paint base is produced.

Corrosion Prevention of Iron and Zinc

U. S. Pat. 2,302,643. J. S. Thompson, assignor to Parker Rust Proof Co., Nov. 17, 1942. A method which comprises obtaining a corrosion resistant coating on a surface composed principally of one of the group consisting of iron and zinc by subjecting said surface to the action of an acidulated solution containing sufficient sulfite to give sulfide in the coating and thereafter treating the coated surface with a dilute solution of chromic acid.

Example:

75% Phosphoric acid	10	cc.
Sodium sulfite	3	g.
Water	1	L.

Treat at 100°F. to form the coating. Acceleration of the action is obtained by adding soluble compounds of various metals in small amounts such as 0.6 g. of chromic sulfate or 4.5 g. of zinc dihydrogen phosphate.

Brightening Electrodeposited Tin Coatings

U. S. Pat. 2,303,035. C. G. Fink, assignor to Crucible Steel Co. of America, Nov. 24, 1942. The process of brightening electrodeposited tin-containing coatings which comprises heating the coating to a temperature above its fusion point in an oil bath containing sufficient uncombined organic carboxylic acid to provide 0.10 — 2.6% of the carboxyl radical by weight of the bath, and rapidly cooling the coating.

Example: Mineral oil plus enough adipic acid to provide 0.10 — 2.0% by weight of carboxyl (COOH) radical.

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

Coolant and Circulating Pumps

Several new coolant and circulating pumps have just been announced by Ingersoll-Rand Company, 11 Broadway, New York City. These pumps include ¾" and 1" side-wall-mounted types, a 1¼" side-wall-mounted type for low-submergence applications, and a 1¼" horizontal type.

These pumps are suitable for installation on machinery requiring a coolant or circulating unit; for example, those types of lathes, drills, automatics, cut-off machines, and grinders which require a constant supply of cooling fluid or cutting oil. Other equipment for which these pumps are suitable includes evaporative condensers, air-conditioning units, washers, etc.

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New York City

Recent Engineering Development to Prolong Anodizing Rack Life

The high cost and short life of sulfuric and chromic process anodizing racks has long been a major problem with many manufacturers.

Naturally, these processes have been extremely hard on rack insulation and the rapid insulation breakdown on these racks has been costly, not only in damage to the racks themselves, but in wasted current and in generator overloads.

A recent engineering development in the insulant field is claimed however, to make anodizing rack protection a reality, multiply rack life, reduce "rejects" to a minimum and reduce current consumption to just what the work requires.

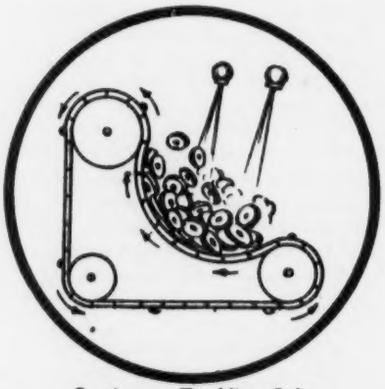
This new insulant, known as "Bunatol," has been engineered by Nelson J. Quinn Compay, Toledo, Ohio. In addition to possessing the other qualities of a superior insulant, the manufacturers claim that "Bunatol" has one outstanding characteristic which is chiefly responsible for prolonging anodizing rack life. This characteristic is permanently greater flexibility.

Pictured here is a typical spring-clip type anodizing rack, "Bunatol"-insulated. This adhesive coating is said to be tough and to provide a flexibility in keeping with that of the spring-clips themselves and therefore does not become brittle, crack or peel when the clips are flexed. Because this flexibility is said to be retained for the life of the insulation, its efficiency is maintained and maximum rack protection provided until the contacts are entirely eaten away.

New Metal Washing Machine

A new small parts washer, designed around a special patented endless tumbling belt, is a recent development announced by American Foundry Equipment Co., 555 S. Byrkit Street, Mishawaka, Indiana, metal cleaning engineers.

This batch type machine receives and discharges the parts to be cleaned through a large front opening. It is similar in its action to the Rotary Drum type cleaning machine in that the work is tumbled to expose all surfaces to the powerful cleaning action of the sprays.



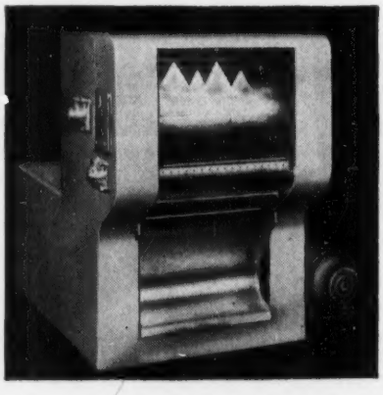
Continuous Tumbling Belt.

The patented open type barrel gives complete access to the parts while in process, and the spray system is also readily accessible for cleaning and inspecting the pipes and nozzles.

The machine is especially well suited for cleaning small screw machine products which can withstand a slight tumbling action. Where the parts are handled in batch form, parts can be washed only, or the wash can be followed with a fresh water rinse with the rinse water draining to a sewer to prevent contamination of the washing solution.

Another layout provides a power wash and a power rinse followed with a compressed air blow-off to remove excess liquid. A special arrangement keeps the two solutions separate and permits washing and rinsing in one compartment without transfer of the parts. To unload the machine, the mill is run in reverse which discharges all parts over a chute.

This new unit is available for heating with steam, gas or electricity and can be supplied with full automatic controls.



New Washing Machine.

EBONOL "C" the BLACKENING PROCESS for Copper and Copper Alloys

EBONOL "C" is unique! It produces hard, adherent, black inorganic finishes (either dull or glossy) on Copper, Brass or Bronze.

It is not a sulphide type black but a cupric oxide finish, with all the physical and chemical advantages of cupric oxide. The coatings are far superior to black nickel, and require no critical materials. The finishes are easy to apply to either large single objects or small parts in bulk. Simple immersion for from 2 to 15 minutes at 200°F is all that is necessary. Control is also simple.

EBONOL "C" finishes are widely used and approved for the blackening of war goods such as optical items, measuring and precision instruments, grommets, wire products and airplane accessories.

Other metals can also be given the superior EBONOL "C" BLACK FINISH by first copper plating.

Other EBONOL Blackening Processes

EBONOL "A" for Aluminum and its alloys
EBONOL "S" for Iron and Steel
EBONOL "Z" for Zinc plate and Zinc alloys

Write for Folder "C" or send samples for processing.

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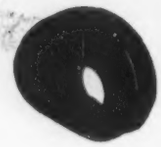

• Today, more than ever, with the increasing necessity for (1) protecting steel parts against oxidation, and (2) adapting low carbon steels to uses where high alloy steels were formerly employed but now given over to armament work—HOUGHTO-BLACK fills a real need in the metal industry.

A recent survey of the extent to which this blackening salt is being used revealed these adaptations:

1. Blackening machine gun mounts and fixtures by the ordnance plant of an aircraft company.
2. As a replacement for chrome and cadmium, a tool manufacturer is now blackening his wrenches, hack saw frames, pliers, etc.
3. Another plant, now making gun carriage parts, now HOUGHTO-BLACKENS these parts, including pins and bearings.

The simplicity of the HOUGHTO-BLACK process makes it readily adaptable to the production line. It provides an attractive and protective finish without altering dimensional sizes. Ask the Houghton Man for details or write to

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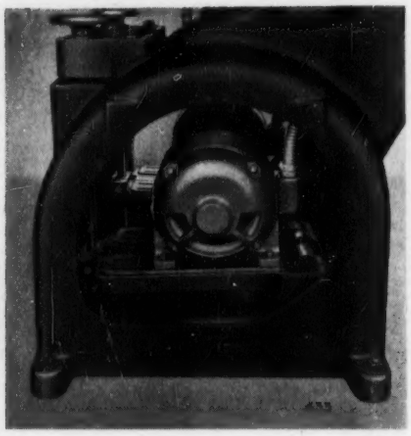

Heavy-duty Polisher and Buffer.

Polisher and Buffer

The Hisey-Wolf Machine Co., Cincinnati, O., are the manufacturers of the new heavy duty polisher and buffer illustrated in the accompanying photograph.

Mounting the motor inside the base permits the use of standard open motors in place of totally enclosed, fancooled motors; thus, a saving in scarce materials.

The machine is built in the single spindle-single motor type as well as the pictured two spindle—two motor style with motors from 3-10 H. P. capacity.

Oil lubrication requiring minimum attention is a feature of the constant level type oilers.

Although open type spindles are shown, encased types can also be furnished with a housing around the spindle extension with a ball bearing directly adjacent to the wheel.

New Weatherproof Lamp

A new 200 watt lamp which is guaranteed not to crack as a result of climatic conditions, even when used outdoors in an open fixture, has been added to the line of weatherproof lamps for general lighting service manufactured by the Radiant Lamp Corp., 260 Sherman Ave., Newark, N. J.

The complete range is now from 200 to 2,000 watts inclusive.

Cup Wheel

Polishing Wheels

Advance Polishing Wheels, Inc., 844 West 49th Place, Chicago, Ill., are the manufacturers of the two polishing wheels illustrated.

The cup wheel is designed for spots which ordinarily are difficult to reach, such as master connecting rods and gears. Its construction permits polishing the flat side of such rods and gear hubs in one operation without "dragging out" the holes.

The saucer wheel is shown in a typical application—in position for polishing the under side of a bolt head while retaining its 90 degree angle. The side of the wheel does not touch the shank of the bolt thereby obviating the danger of marring the thread.

Saucer Wheel

Manufacturers' Literature

Thermometer Bulletins

Wheelco Instruments Co., Harrison & Peoria Sts., Chicago, have issued five new bulletins describing their line of industrial indicating, recording and control thermometers.

Bulletin G23-2, of 12 pages, discusses the operating principle of Wheelco thermometers, and gives information to aid the user in selecting the proper instrument for his application. A table gives details on the characteristics, performance and limitations of each class of vapor-pressure and gas-filled instruments. Similar information to aid in selection of bulb and socket materials, and of capillary and its armor, is also included. Available scales for indicating instruments and charts for recording instruments are illustrated.

Bulletin G503-2 covers the company's recording control thermometer, while G603-2 is on the Wheelco indicating control thermometer. Both bulletins, of eight pages each, discuss the company's "electronic principle" of effecting control without mechanical contact between measuring and control sections of the instruments. Also described are program and proportioning thermometers, available in both recording and indicating types, and combinations of thermometers with the company's "Flameotrol," a combustion safeguard instrument. Schematic drawings are included.

Bulletin G303-2, two pages, describes and gives applications for the company's indicating thermometer, while Bulletin G403-2, two pages, covers its recording thermometer.

Degreasing and Cleaning Manual

Forty-three essential production degreasing and maintenance cleaning operations in aircraft and accessory manufacturing plants are reviewed in the second edition of a newly revised, enlarged 40-page manual issued by *Oakite Products, Inc.*, 18 Thames St., New York, N. Y.

Of special interest to process engineers and production superintendents are the practical data given on the uses of tank immersion, washing machine, acidic, solvent, steam-detergent and pressure-spray methods for handling many degreasing and cleaning operations. Among those discussed are safely preparing aluminum alloy parts before resistance spot-welding; degreasing ferrous and non-ferrous metals before such fabricating operations as heat-treating, Magna-flux testing, pickling, inspection and assembly; rust-proofing parts between operations; cleaning aluminum, magnesium and their alloys before anodizing or other protective chemical surface treatment, and degreasing work preparatory to electroplating, painting, black finishing, etc.

The manual also gives considerable information on the many different, commonly recurring problems encountered in aircraft and accessory manufacturing plants in connection with production equipment maintenance and general plant housekeeping and sanitation work. Free copies of this informative manual will be sent to all aircraft executives on request.

Day by day metal finishing production problems get tougher. Yet ways to solve them must be found . . . *but quickly.*

That's where a task force of correctly compounded metal finishing materials applied by McAleer Finishing Specialists to answer your specific metal finishing requirements comes in.

McAleer Metal Finishing Specialists think in terms of new finishing ideas, new methods . . . faster, better ways to get the job done. What's more, they know how to combine these ideas with 18 years of experience plus a practical knowledge gained by working with scores of war production plants to help you finish your job better, faster, at lower cost.

You will find the value of this service written in the production records of many manufacturers who are working today under greater pressure than ever before. A task force of McAleer *Quality-Controlled* metal finishing materials, correctly applied by Finishing Engineers who know their job and do it well, has helped blast open some pretty tough production finishing jams . . . and that is exactly the kind of job we would like to do for you.

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ROCHESTER, MICHIGAN

Stop-Off Paint for Carburizing

Park Chemical Co., 8074-8110 Military Ave., Detroit, Mich., have issued a two-colored, illustrated folder descriptive of their "No-Carb" selective carburizing medium.

This liquid paint is recommended to prevent both carburization and decarburization and may be applied by dipping, brushing or spraying.

Bulletin on Rectifiers

"Rectifiers for Electroplating, Anodizing and Electrotyping" is the title of bulletin ER-103, issued by the *Hanson-Van Winkle-Munning Co.*, Matawan, N. J. describing in detail the company's copper oxide rectifiers and their construction, operation and operating characteristics. It also gives answers to a number of questions which come up in actual practice.

These rectifiers are made in units ranging from 300 to 2000 amp. at 6 v., and from 150 to 1000 amp. at 12 v. Special rectifiers of larger sizes are also produced.

The bulletin is profusely illustrated with photographs, charts and diagrams.

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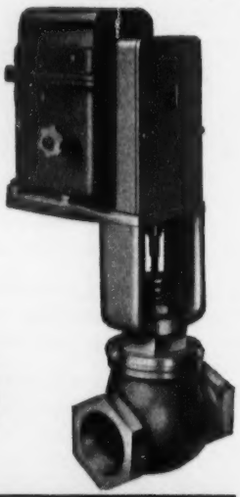

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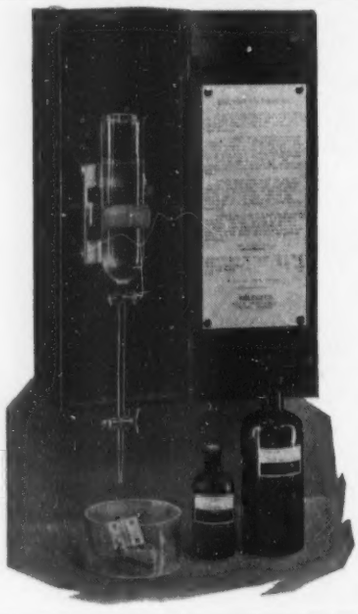

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Obituaries

Floyd T. Taylor

Floyd Thomas Taylor, former vice-president and general manager of A. P. Munning & Co., died on January 9th from a heart ailment. He was 63 years old.

Mr. Taylor was born in Richmond, Va. He attended St. Paul's Preparatory School in Garden City, N. Y., and was graduated in 1903 from Massachusetts Institute of Technology with a degree in electrical engineering.

After leaving A. P. Munning & Co. (now Hanson-Van Winkle-Munning Co.), he became associated with the Bullard Co., Bridgeport, Conn., where he was in charge of the Bullard-Dunn Process. He had also been with the General Electric Company at Lynn, Mass. and the Cutler-Hammer Company, Milwaukee.

Mr. Taylor was a member of the American Society of Metallurgical Engineers and the American Electrochemical Society. He was also a member of the University Club in Bridgeport and the Engineers' Club in New York.

Mr. Taylor leaves his widow, the former Anita Goldschmidt of Milwaukee; a son, Captain Floyd T. Taylor, Jr., now at Fort Benning, Ga.; a daughter, Mrs. Edward A. Norman, Jr., of Columbus, and a brother, Colonel C. B. Taylor of Churchland, Va.

Mr. Taylor, who was president of the Matawan Civic Club, lived at 311 Main Street, Matawan, N. J.

John C. Scheeler

John C. Scheeler, 55, president of the Buffalo Wire Works Company and vice-president of the Buffalo Galvanizing and Tinning Works, both of Buffalo, N. Y., died of a heart ailment on December 14th in the General Hospital of that city.

Mr. Scheeler was born in Buffalo, attended public schools there and began working as an office boy at the age of 14 in the wire company then known as Scheeler's Sons which was headed by his father. He was chosen president in 1926 on the death of his father, Martin Scheeler.

New Books

Ferrous Production Metallurgy. By John L. Bray. Published by John Wiley & Sons, Inc., 440 4th Ave., New York City. 1942. 457 pp. Price $4.00.

This is a textbook on the production of iron and steel which covers all phases of the subject with condensed descriptions of equipment accompanied by simple, clear line drawings which give only the principal details, thus avoiding the confusion caused in the reader's mind by photographs and working drawings.

A full chapter is given to each of the following: blast and electric furnaces, acid and basic open hearth, Bessemer, cementation and crucible processes. In addition,

the book includes short chapters on the characteristics of iron, scrap and ferroalloys.

Although the metallurgist will be familiar with the subject matter, this volume will make very interesting reading for those unfamiliar with the production of ferrous metals.

Handy & Harman, 82 Fulton Street, New York, N. Y., have issued their 27th annual review of the silver market for 1942 in which the outstanding feature was the transition of silver from civilian life to active service in our war effort, a transition which at times involved sharp conflict between the natural law of supply and demand, politics and control administered by government agencies.

The reports on foreign markets naturally are limited to those countries from which information has been available, and are, therefore, incomplete. However, the changes in the silver situation in the United States are recorded in great detail.

With the failure of the Green bill last December, there is very little hope held out for non-essential users of silver who can not expect relief unless some legislation similar to the Green bill in its original form is enacted in 1943. Even if the Green bill had been passed by the last Senate, it would probably have made no difference to them, as very little relief was offered non-essential users by the bill in its amended form.

Bibliography of the Literature Relating to Constitutional Diagrams of Alloys. By J. L. Haughton, (Institute of Metals Monograph and Report Series, No. 2). The Institute of Metals, 4 Grosvenor Gardens, London, S.W. 1. 1942. 163 pp. Price: 3s 6d post free.

This bibliography contains over 5000 references to papers dealing with the constitution of binary, ternary, and higher alloy systems, both ferrous and non-ferrous. References have been included not only to papers of a purely constitutional character but also to many X-rays and physical-property studies of alloys, which have some bearing on the constitution.

To furnish some guide among the references (which in a few systems exceed 100), asterisks have been placed against those in the originals of which a new equilibrium diagram, or portion of one, is to be found.

It is intended that the bibliography shall be used in conjunction with the abstracts that the Institute has published since its foundation, first in the *Journal* and then in *Metallurgical Abstracts* (Series II). For convenience, therefore, references have been included to these abstracts, whenever such exist.

The bibliography is thoroughly up to date and contains references to all papers seen up to the time of going to press. It should prove invaluable to all research workers in metallurgy, works' metallurgists, and others interested in the constitution of metallic alloys.

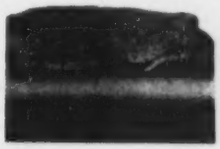
A NEW, HIGHLY EFFICIENT PROTECTIVE COATING

for Coils Used In Rustproofing Systems

Koilkote is a new protective coating material developed especially for use on steel coils in rustproofing systems. It provides the means to save hours of time usually spent in removing deposits and to lengthen the useful life of the coils.

One Detroit manufacturer now using Koilkote reports that, previous to using this material, the coils in his rustproofing system were removed and cleaned once every two weeks. It required almost a full day for one man to remove the deposit with a sledge hammer. Now the coils are removed every five or six weeks and one man can clean them in less than an hour.

With Koilkote, deposits do not form as heavily or as quickly on the coils. As a result, there is little appreciable difference in the heating efficiency of the coils between cleaning periods. Koilkote is quickly applied and, while it adheres firmly to the steel surface, it and the deposits which form on it are easily removed. Write for full details.



KOILKOTE SAVES COIL. Heavy deposits such as are illustrated here must be removed with a sledge hammer with the obvious possibility of damaging the coils. With Koilkote, lighter deposits and ease of removal eliminate this cause of damage.

KOILKOTE

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Technical Publications

Methods of obtaining new and stronger tin-base alloys suitable for use as bearing metals constitute part of the program of research conducted by the Tin Research Institute.

The effect on hardness produced by quenching from the highest practicable temperature followed by prolonged tempering at 100°C. and 140°C., has been examined for 80 tin-base alloys containing 4 to 14 per cent antimony and 0 to 10 per cent cadmium. The results of the hardness tests are recorded in a paper by W. T. Pell-Walpole, B.Sc., Ph.D., in the Journal of the Institute of Metals, Vol. 68, October 1942.

It is shown that these alloys can be hardened by heat treatment and maintain a useful degree of improvement for at least 1,000 hours at 100 to 140°C. The best alloys in this respect are those in the range antimony 9 to 10 per cent, cadmium 1 to 1½ per cent, balance tin. The degree of improvement is indicated by Vickers diamond pyramid hardness tests. Values of 33 to 34 are obtained, compared with values of 26 to 30 in the normal non-heat-treated condition.

Reprints of this paper may be obtained free of charge from the Tin Research Institute, Fraser Road, Greenford, Middlesex, England.

Electrodeposition of Manganese. No. 15, Hydrometallurgical Studies of Manganese Ores by David Schlain. Bureau of Mines Report of Investigation 3651. Mimeographed.

Soap Specifications P-S-536-a. Soap and Soap Products. General Specification. (Methods of sampling and testing). Price: 10c.

Above literature is obtainable from Superintendent of Documents, Government Printing Office, Washington, D. C., at cost where indicated.

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Associations and Societies

The Electrochemical Society

Nominees for the office of president of The Electrochemical Society for the year 1943-1944 are Oliver Wendell Storey, G. B. Hogaboom, Sr. and Robert M. Burns.

American Electroplaters' Society

Annual Convention

The committees in charge of the National American Electroplaters' Society Convention to be held in Buffalo on June 7th, 8th and 9th, 1943 are busy rounding off the corners to produce a convention that will give an effective boost to the war effort.

Meeting at least every two weeks, the committees are straightening out details and developing new ideas; one in the making is a "Bull Session" where the free exchange of ideas will be featured.

Convention Headquarters will be the Statler Hotel which has ample facilities to handle all the activities of the convention including meetings, exhibits, the banquet and rooms for those attending.

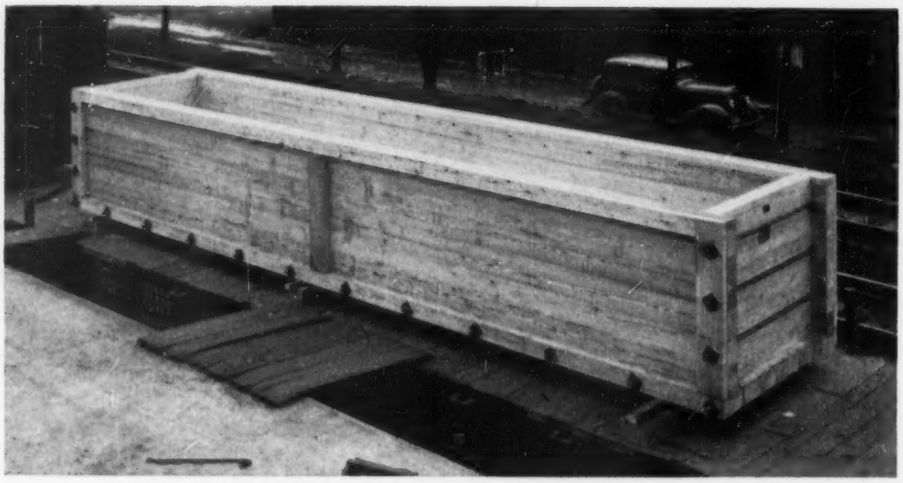
All talks are to be devoted entirely to ways and means for increasing war production.

W. M. Fotheringham, 410 Bird Ave., Buffalo, N. Y., is Chairman of program publicity.

Chicago Branch

The 31st Annual Educational Session and Dinner Dance of the Chicago Branch of the A. E. S. was held at the Palmer House in Chicago on Saturday, the 23rd of January.

The following three talks were delivered at the Educational Session: "Blackening of Ferrous and Non-Ferrous Alloys" by Dr. Walter R. Meyer, Technical Director of The Enthone Co., New Haven, Conn.;



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"Recent Developments in Zinc Plating" by Mr. Myron B. Diggin, Chief Chemist, Hanson - VanWinkle - Munning Co., Matawan, N. J. and "Deposition of Alloys" by Dr. Charles L. Faust, Battelle Memorial Institute, Columbus, O.

New England Regional Session and Banquet

The annual New England Regional Educational Session and Banquet will be held at the Hotel Bond, Hartford, Conn. on May 1st, 1943 according to an announcement received from Arthur W. Logozzo.

Los Angeles Branch

Methods and problems of plating on magnesium were discussed in a paper presented at the January 4 meeting of the Los Angeles Branch of the A.E.S., by *James P. ApRoberts*, Los Angeles aircraft processing engineer.

The session was the first held by the branch in its new meeting place, the Los Angeles Elks Club, Sixth and Parkview Streets.

Marcus Rynkofs, Chairman of the Dinner-Dance Committee, reported that at a meeting held December 22, the committee had voted approval of tentative plans for holding the annual educational session and ball in the Elks Club on a still-to-be-determined date in March. Reservations for the dinner totaling 160, which have already been received, presage a successful affair despite wartime restrictions, Mr. Rynkofs stated. The products exposition which has been a part of the branch's annual educational session will be held again if sufficient exhibitors can be obtained.

Applications for membership were received from *Arch J. Peverly*, Superior Plating Co., active; *G. J. Young*, National Supply Co., active, and *J. L. Damon*, General Chemical Co., associate.

News From California

By Fred Herr

A new fusion method of welding now employed at the plant of the *Northrop Aircraft, Inc.*, Inglewood, Calif., reportedly makes it possible for much strategic magnesium metal, already fabricated but with small defects, to be quickly and easily restored to usefulness.

Consisting of a helium arc method of welding magnesium alloys, the new fusion method is reported to have been brought about by close wartime cooperation of *Northrop Aircraft* and *Dow Chemical Co.* The process takes advantage of the peculiar properties of helium, an inert, non-explosive and non-inflammable gas.

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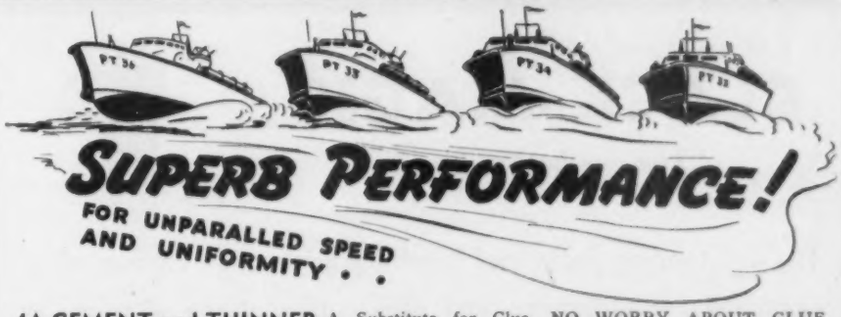

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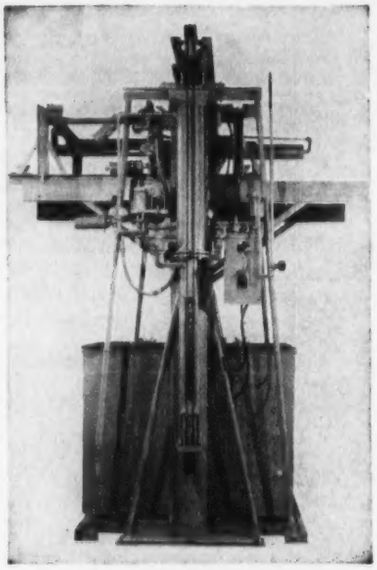

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Of major significance is the fact that vital aircraft sand castings, some of which formerly were discarded because they did not meet standard specifications, now can often be reclaimed by the new process.

The new method is expected to have an important bearing on war production progress. Its advantages over other methods are said to be the elimination of rivets, ease of operation and increased speed of production over a wider range of design.

Cannon Electrical Development Co., Los Angeles, has installed a conveyor type, three-compartment degreaser for handling degreasing on contact points of cable connectors in its finishing department.

Marcus Rynkofs, president, *Liberty Plating Co.*, Los Angeles, returned December 30 from an inspection tour of the new basic magnesium plant at Las Vegas, Nev.

Cadmium Nickel Plating Co. is installing three new zinc tanks, a barrel unit and two still tanks in its plating room at 1400 Long Beach Ave., Los Angeles.

The company also broke ground in December on a new 50′ x 50′ building to be used for barrel drying and storage. Including a 40′ x 120′ building completed in October, 1942, Cadmium Nickel Plating Co. now has some 18,000 square feet of floor space devoted to metal finishing and polishing.

The firm is doing considerable war work in the form of cadium plating of landing gears and other plane parts for Southern California airplane plants.

William Venzel, Southern California sales representative for *Detroit Rex Products Co.*, Detroit, for the past several years, has been transferred to the southeastern states territory, with headquarters at Atlanta, Ga.

Oscar Snodgrass, 36, General Supervisor at *Norris Stamping & Manufacturing Co.*, Los Angeles, died on December 25. He is survived by his widow, Mrs. Martha Snodgrass; his mother, Mrs. Jesse Snodgrass; a son, Richard; a daughter, Gail; two sisters and one brother.

Castelay Metal Sales Co. has been established at 3053 Treadwell Ave., Los Angeles, by *Theodore M. Curtis.*

The Victor Chemical Co. has been opened at 1151 S. Broadway, Los Angeles, by *Dennis H. Jackson.*

The Payton chromium deposit in the Pine Grove field of California has been leased by Seattle interests who are reported to be preparing to install heavier mining equipment.

Simultaneously it was learned that Amador County, Calif., mine operators have petitioned Metals Reserve Co. to establish a chromium and manganese stockpile at Martel to supplement the stockpile already in operation at Tracy.

Pacific Mining Co. announced completion of a new chromium concentrating plant in the Marsh Flat area of Tuolumne County, Calif , on January 4. The unit is reported as having a capacity for treating 100 tons of ore daily and producing 30 tons of concentrate averaging 45% chromate. Operation started the second week in January.

The company has several chromium deposits at Marsh Flat under option, development of which has been underway for several months.

New firms with metal finishing or processing departments, established in Los Angeles during December and January, are the following:

Luman Screw Products Co., 4340 E. Slauson Ave., *Ray L.* and *E. V. Luman.*

Northside Tool & Die Works, 2729 N. Main St.; *LeRoy E.* and *L. J. Cassou.*

Fabrication Steel Products Co., 4900 Cecelia St., Bell, Calif.; *Fred P., P. S.* and *Mario R. Glick.*

Keystone Tool & Supply Co., 7720 Maie Ave., Los Angeles; *Walter E.* and *T. I. Smith.*

Mangachrome Co. has announced the development of a massive manganese deposit in Grass Valley, Calif. Approximately 40,000 cubic yards of waste have already been stripped from the ore body, which has shown a 40 foot depth. Installation of a washing plant is under way.

Roy S. Gangestad, president of the *United States Metals Corp.*, Los Angeles, announced January 11 that a new vein of copper, eight feet wide, yielding 10 per cent copper, had been discovered in the firm's Kaibab properties at Jacob Lake, Coconino County, Ariz.

Gangestad declared the new strike will probably justify the erection of a 250-ton mill.

Shipments of manganese ore are now going out from the Schmidt deposit, 27 miles south of Tracy, Calif., operated by *O. E. Chaney* and associates. The vein is reported 14 inches to four feet wide in surface workings, with tests showing 61% manganese.

The *Aircraftsmen Co.* has been established at 223 Hindry Ave., Inglewood, Calif., by *Arthur C. Chester* and *Albert P. Clausen.*

Business Items

New Pacific Office Opened by Detroit Rex

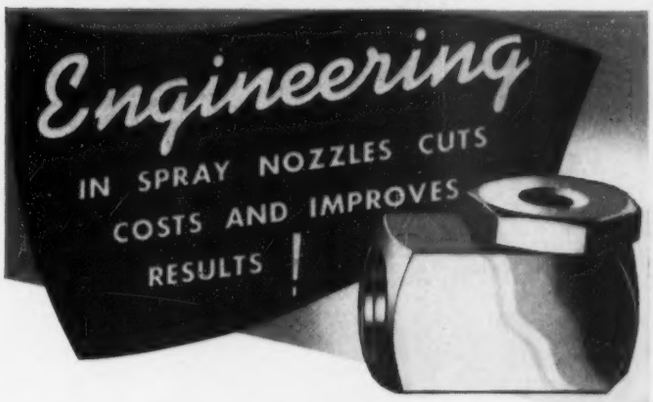
The Detroit Rex Products Co., metal cleaning engineers, have moved their Los Angeles office to new and larger quarters at 1506 Santa Fe Avenue. Occupying more space, the new offices will enable the company to offer the best cleaning service possible to industries in the Southern California territory.

S. B. Crooks, transferred from the Mid-Western Region with offices in Chicago, became the manager of the Pacific Region January 1st, 1943. His new headquarters are in the Los Angeles office.

W. A. Vensel, formerly Pacific Region Manager, now supervises sales and service in the southern states.

As a result of concentrated diamond drilling, *Calumet and Hecla Consolidated Copper Co.*, 1411 Central Ave., Detroit, Mich., have discovered a moderate size conglomerate ore body. The attractiveness of this discovery is such that plans are being made to sink a shaft immediately, and it is hoped that if critical materials are available, production of copper will start within eight months after receipt of the needed equipment. It is planned to mine at the rate of 1000 tons a day once the development is under way.

At the meeting on Tuesday, January 26, in Boston, *Endicott R. Lovell*, who is a director and general manager of Calumet and Hecla Consolidated Copper Company, was made a vice president; *Robert Livermore*, who is a director and consulting engineer, was made a vice president; and *Otto Z. Klopsch*, who is general manager of the Wolverine Tube Division of the company, was made a director and vice president.



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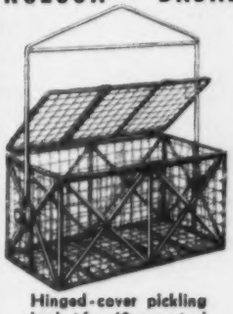

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J. B. Ford and Michigan Alkali Consolidate as Wyandotte Chemicals Corporation

The J. B. Ford Co. and *Michigan Alkali Co.*, its affiliate, have consolidated as one company to be known as *Wyandotte Chemicals Corporation*. The consolidation, which combines in a single organization one of the largest producers and distributors of chemicals and the world's largest manufacturer of specialized cleaning materials, was effective January 1.

E. M. Ford, formerly a director of The J. B. Ford Company, is president of the new corporation. In his announcement he said the consolidation will entail no change in ownership nor will any new personnel be included in management. It is being effected, he said, solely in the interest of more efficient operation and distribution. E. M. Ford occupies the position which was to have been assumed by his father, E. L. Ford, grandson of Captain John B. Ford, founder of the business. Mr. E. L. Ford died suddenly on December 20.

I. H. Taylor

Bert Cremers

The sales departments of both companies will temporarily maintain their separate identities as divisions of Wyandotte Chemicals Corporation, whose production is largely devoted to war effort and essential civilian needs. In addition, *The J. B. Ford Division*, of which *C. B. Robinson* is vice president in charge of sales, will cover dairies, laundries, bottlers, metal cleaners, hospitals, institutions, brewers, railroads, and other industries not specifically assigned to Michigan Alkali, and will

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LaMotte Block Comparators

for pH tests to accurately control the acidity and alkalinity of nickel, zinc, tin or cyanide baths. Inexpensive and easy to operate. A test can be made in a few minutes.

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for accurately determining and regulating the acid and copper content of the bath to insure uniform results.

Other LaMotte Outfits for determining Chlorides, Nickel Content, Iron Content and positive control of Cyanide Copper, Acid Zinc, Cyanide Zinc, Cadmium, Brass and Bronze plating solutions.

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continue to promote the sale of Wyandotte cleanser for home use. In addition to war production, the *Michigan Alkali Division*, headed by *Bert Cremers*, vice president in charge of sales, will be responsible for sales in the glass, soap, paper, chemicals (carload lots), flour mill, rayon, oil refinery, synthetic rubber, steel, aluminum, coal mine, and public highway industries. Both divisions will call on textile and railroad customers.

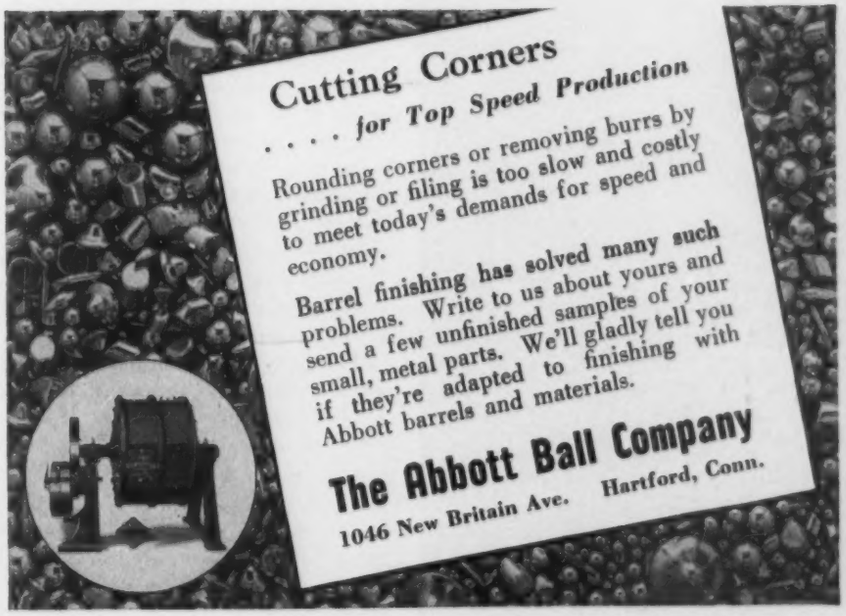
The J. B. Ford Company was created in 1898. It has developed into the world's largest manufacturer of specialized cleaning materials and an important factor in promoting sanitation and safe-guarding the health of America.

The Michigan Alkali Company, which is one of the largest producers of soda ash, caustic soda, chlorine, dry ice, calcium carbonate, bicarbonate of soda, and other chemicals used in virtually all industries, was established 52 years ago.

Dr. Charles F. Bonila, associate professor of chemical engineering at Johns Hopkins University and Spanish editor of the Transactions of the Electrochemical Society, has returned from an extended trip through Brazil under U. S. Government auspices.

E. T. Asplundh, vice president, *Pittsburgh Plate Glass Co.*, announced the appointment of *W. I. Galliher* as executive sales manager of the Columbia Chemical Division, manufacturers of heavy industrial chemicals, including alkalis, chlorine, calcium chloride, and specialties. Mr. Galliher, formerly director of sales, succeeds *Eli Winkler*, who is retained in the capacity of executive consultant.

The Chemical Division's executive sales offices were transferred from New York, N. Y., to the general offices of the company in Pittsburgh, Pa., on September 1, 1942, completing the program of coordinating all activities of the company's several divisions at central headquarters. Mr. Galliher will maintain his office in the Grant Building, Pittsburgh, Pa.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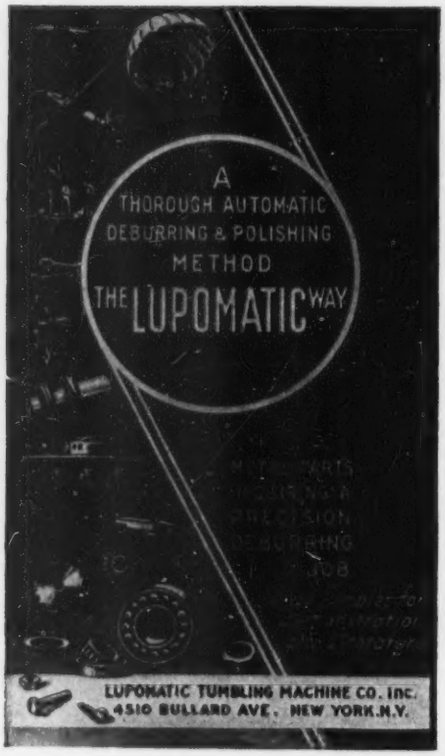

Synthetic Rubber Replaces Natural Rubber

Synthetic rubber, made in recently completed government-financed plants, is currently being sold to rubber manufacturers and used to replace natural rubber in a number of articles, according to *W. S. Richardson*, general manager of the Industrial Products Division of *The B. F. Goodrich Co.*

The first of the American rubbers to be produced under the nation's large synthetic rubber program are being specified for various types of hose and other products in which resistance to the action of oil and gasoline found in certain types of synthetic rubber is desired.

"The United States will produce only about 30,000 tons of all types of man-made rubber this year," Mr. Richardson said. "However, it is expected that more than 300,000 tons of rubber will be turned out of government plants next year so that the number of products in which the new synthetics are used will constantly be increased."

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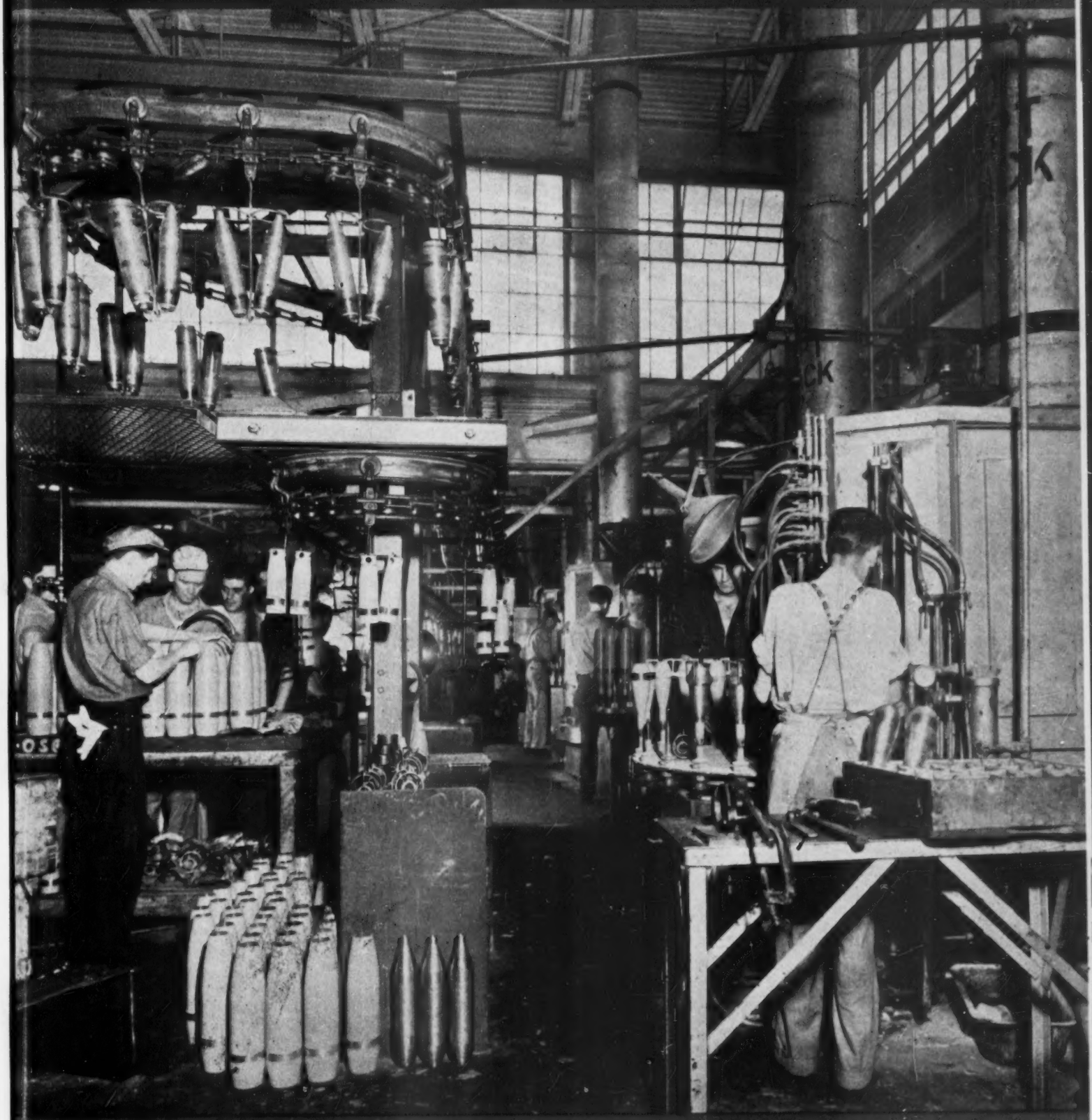

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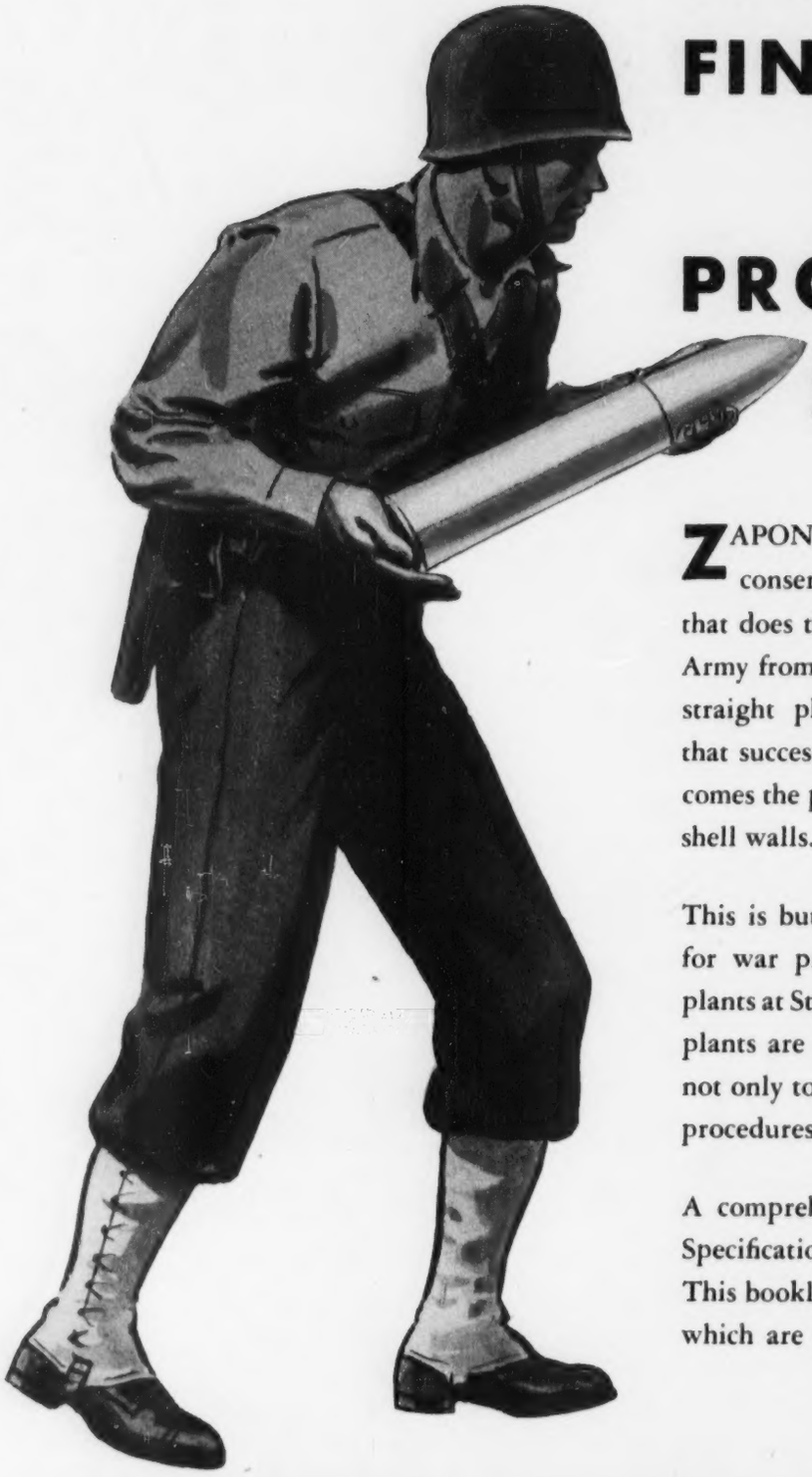

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SECTION OF METAL FINISHING

FEBRUARY, 1943

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DEPARTMENTS

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Picture On Cover

The picture on the cover is shown through the courtesy of the DeVilbiss Company, Toledo, Ohio. It shows an installation at the Budd Wheel Company plant, Detroit, Michigan, the view being of the general painting line for all shells turned out by the Budd Company. A row of DeVilbiss rotary-type automatic spray machines for shells appears at the right, while the shell inspection bench is shown at the left.

New Finishing Material Containers

In normal times a tremendous amount of metal is used in the manufacture of containers for finishing materials. Steel, of course, is the largest item but appreciable quantities of tin, lead and zinc are used in the form of tin plate, terne plate and galvanized iron. All of these metals are extremely important for direct use in war items and it is not surprising that restrictions have been placed on their use for the manufacture of cans, pails and drums.

Faced with the prospect of declining supplies of metal for containers for enamels, paints, lacquers, etc., the finishing industry began some time ago to give serious study to containers made of materials other than metals which might be used. One possibility was glass bottles and jars. It was found that glass containers fitted with metal or plastic caps could be adapted readily to the needs of the industry, particularly in the smaller sizes. Another possibility, also for smaller sizes, was containers made of paper board. These required some development but were, nevertheless, potential replacements. A third possibility, for the larger sizes, was wood buckets and barrels. Such containers were not new but had been used by the finishing industry in the past and could be used again.

That some success in replacing metal containers has been accomplished is evidenced by the appearance of glass containers of paints and enamels on the market. We may expect to see more of these and the other substitutes mentioned. It goes without saying that, although other containers have their advantages, there is no one hundred per cent replacement for metal containers. However, it is satisfying to know that the finishing industry can get along with other types of containers in order that the metals previously used for them can go into ships, guns and planes.

L. H. LANGDON, *Publisher* • T. A. TRUMBOUR, *Business Manager*

THIS IS WASHINGTON—

By George W. Grupp
METAL FINISHING's Washington Correspondent

Alcohol Production Expansion To increase the production of industrial alcohol, the Defense Plant Corporation bought machinery and equipment to the amount of $700,000, which will be operated by the National Distillers. The DPC also bought an unrevealed amount of equipment to be operated in the Missouri plant of the Woodford Distillery, Inc.

Alkanolamines Under Allocation Control Such alkanolamines as monoethanolamine, diethanolamine, and triethanolamine were placed under allocation control by Allocation Order M-275 on January 9, 1943. This order was issued to divert the use of these materials from the making of such civilian products as polishes and waxes to the making of war items. Chemical Allocation forms PD-600 and PD-601 must be used in making reports on the tenth of each month. Exemptions from the restrictions of this order are the delivery of 5 gallons or less of monoethanolamine or diethanolamine, and 55 gallons or less of triethanolamine, during any calendar month, to any one person.

Aluminum Paint Order Extended Supplementary Order M-1-g which was to expire by its original terms on December 31, 1942, the WPB Director General for Operations has ruled shall continue to remain in effect until revoked. This order controls the use and distribution of aluminum paints, pigments, and liquids.

Bronze Powder Control Shifted Supplementary Conservation Order M-9-c-3, as amended December 28, 1942, now governs to the exclusion of Conservation Order M-9-c the "use of bronze powder in the manufacture of paste, ink and leaf, of paint (except ship bottom paint), of other coatings (except decalcomanias) and of any other bronze powder and such bronze powder products in the manufacture of other articles."

Bronze Powder Inventories Released Supplementary Conservation Order M-9-c-3, as amended December 28, 1942, released about 500,000 pounds of bronze powder and bronze powder products because it was said to be "unsuitable for any war or essential civilian purpose". The bronze powder may be used only for the finishing and coating of a limited number of articles. The production of bronze powder for non-essential purposes as restricted by Conservation M-9-c is still in effect.

Bucket and Pail Restrictions Manufacturers were prohibited from selling, leasing, trading, shipping, and delivering of zinc coated, japanned, painted or lacquer finished new pails and buckets except as receptacles for oily rags or oily paper in industrial plants and for the preparing and manufacturing of chemicals, according to Supplementary Limitation Order L-30-a, as amended January 15, 1943.

Cobalt Restrictions Removed On December 28, 1942 the Director General of Operations issued Amendment No. 1 to General Preference Order M-39, as amended December 11, 1942. This amendment permits the use of cobalt in all driers. The restrictions on the use of cobalt in driers were found to prevent the manufacture of certain essential protective coatings such as ship bottom paint, camouflage paint, and other protective coatings.

Glass Paint Jars Order Amended Schedule E of Limitation Order L-103, as amended January 16, 1943, which standardized glass paint jars, extended the time of permission to use non-standard jars to relieve hardships on glass and paint manufacturers. After March 31, 1943 jars of one quart or less capacity with an opening larger than 63 mm. may be used only for packaging certain heavy-bodied paints, regardless of the date of their manufacture. In the earlier order these jars were prohibited after December 7, 1942. The heavy-bodied paints not subject to the restrictions are (1) paints which require the addition of more than one pint of thinners per gallon to make the paint ready for use, and (2) colors in oil and japan, and tinting colors in paste form.

Glycerine Price Order Amendment Among the most important changes in the January 2, 1943 amendment No. 4 to Revised Price Schedule No. 38, was the elimination of the requirement for filing reports with OPA. The amendment makes no changes in prices fixed in earlier regulations except that the sections dealing with imports, licensing of distributors and taxes were revised to bring such provisions in conformity with similar sections in other price regulations.

Industrial Alcohol Committee Meeting At the meeting of the Industrial Alcohol Industry Advisory Committee held in Washington on January 14, 1943, the Wheat Alcohol Research Committee presented a report on the production of alcohol from granular wheat flour. The report was based on experiments conducted by nine different companies. This report states that 56 pounds of granular wheat flour yields about 5.45 proof gallons of alcohol, as compared with 4.6 proof gallons from 56 pounds from whole wheat, and with 5 proof gallons from whole corn.

Insulating Varnish Industry Meeting The WPB Protective Coatings Section of the Chemical Division told representatives of the Electrical Insulating Varnish Industry, at an informal meeting held in Washington on January 8, 1943, that some formulas were sought which would make use of a variety of different materials which would involve a study of the use of linseed oil in combination with phenol resins, oiticica oil and castor oil. The WPB officials also suggested an increased usage of surface coatings for cloth, an increased usage of varnishes for coils and wound apparatus, an increased usage of enameled wire, and an increased usage of electrical insulating finishing varnish.

Combustion Safeguards for Metal Finishing Equipment

By THEODORE A. COHEN

Chief Engineer, Wheelco Instruments Co.

THE possibility of explosions in direct-fired industrial ovens remains one of industry's most serious hazards. An explosion may involve injury or death to employees, as well as physical damage to equipment, breakdown in production, and disablement of other parts of the plant and equipment by fire resulting from the explosion.

Elimination of explosion hazards is gaining increased attention as management seeks every means of protecting and extending the life of equipment now installed.

The production speedup in most branches of the metal industry occasioned by the war program has often transferred to relatively new hands the responsibilities for tending equipment in which explosion hazards exist. To offset this greater danger, as well as to provide permanent protection against loss of life and shutdown of plant due to human failure, combustion safety equipment is being relied upon more and more to remove the explosion hazard.

Present-day combustion safety equipment has proved more trustworthy than the human operator in preventing explosions under unexpected circumstances in industrial ovens. It provides protection at low cost—at a very small fraction of the cost of the equipment and plant given protection.

Of the various fuels used by industry, gaseous fuels are sometimes considered of greatest potential hazard from an explosion standpoint. Yet they often are treated with more carelessness than seemingly less hazardous fuels. Coal-and oil-fired equipment are not to be disregarded when considering combustion safeguards, as gases distilled from these fuels in a hot combustion chamber present a serious hazard. Explosions with electrically fired equipment have occurred in industrial drying ovens where solvent vapors are given off in the drying process.

Records of one underwriting organization show 44 oil-fired explosions, 13 gas-fired explosions and 12 pulverized coal explosions in all classes of direct-fired equipment during a given period. These figures do not prove oil-fired equipment less satisfactory from a safety standpoint, as there was a more wide-spread use of oil-fired equipment in the risks covered, but they do show the hazard to be serious in each of the three types of fuels most generally used.

Further analysis of these explosions indicate 45 per cent were due to lack of burner safeguarding, or lack of flame failure safety equipment; 35 per

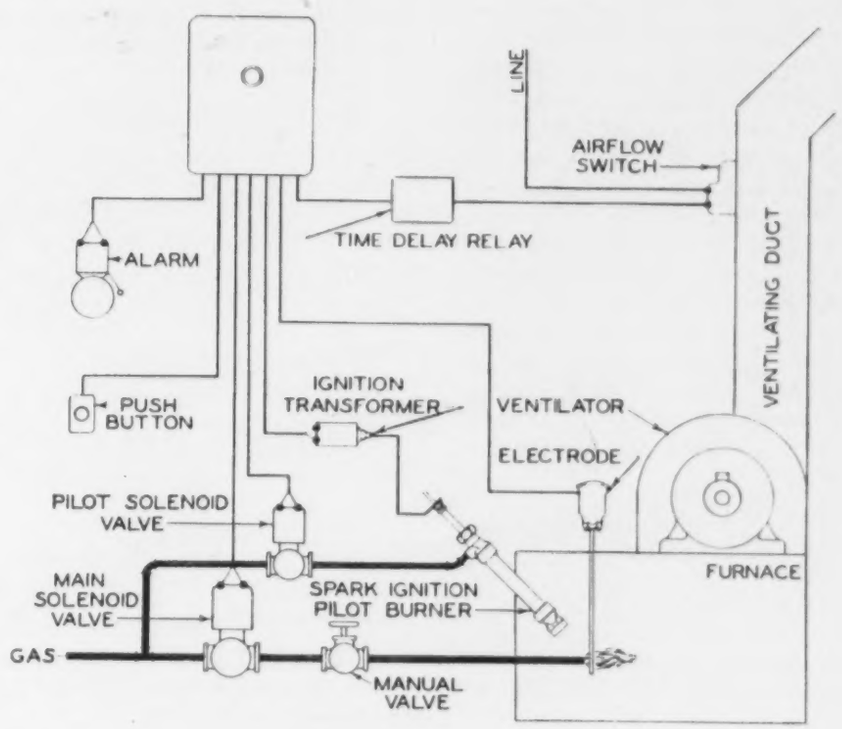

Fig. 1. Diagram of Gas Fuel Hookup with Provision for Controlled Purging of Combustion Chamber.

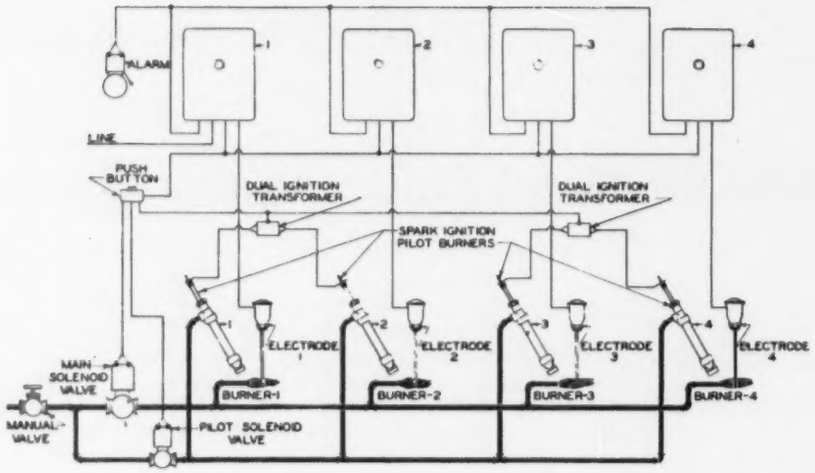

Fig. 2. Diagram of Multiple Burner Gas Fired Oven Hookup Equipped with Combustion Safeguards.

cent to defective burner operation, including clogging; 8 per cent to poor burner maintenance, 3 per cent to distribution deficiencies, and 9 per cent were miscellaneous and undetermined.

While mere use of a fuel does not necessitate an explosion in every case, it is equally true that no oven and no fuel is immune from possible explosion hazards without combustion safeguards. Explosions occur in home furnaces as well as in industrial equipment.

Explosions in Starting

The greatest number of explosions in industrial ovens occurs in starting, particularly in gas-fired units. Fuel may leak past valves in the fuel line, to accumulate in the combustion chamber where an explosion may result on insertion of the lighting torch or ignition of the pilot burner. Likewise, unburned fuel, in the case of oil and pulverized coal, may accumulate in the combustion chamber, and the gas distilled from it, upon mixing with air, may produce an explosive mixture that can be ignited during the lighting procedure.

Ignition may be accidentally lost with decrease in fuel feed, or with fuel feed resumed after stoppage without repeating the proper lighting cycle. A part of the oven may maintain sufficient heat for a short time to ignite the re-established fuel and provide an explosion.

A third explosion cause is a decrease in air supply to an extent where unburned fuel may accumulate in furnace or flues and ignite when proper fuel-air ratio is restored, or if the unburned fuel condition is changed to a condition of slightly abnormal excess air. This occurs more readily with oil than with gas. Raw fuel entering the combustion chamber may not be completely consumed, due to insufficient oxygen brought about by air supply fan failure or some other cause. The fuel accumulates in some portion of the combustion chamber, and when the air supply is re-established, the gas in the pocket is diluted to present an explosive mixture.

Prevention of Explosions

It is apparent on analysis of the above explosion hazards that explosions cannot occur:

1. If the combustion chamber has been purged of all fuel or hazardous vapors;

2. If, after purging, an ample igniting flame from a torch or some other source is properly applied to each burner before the fuel is turned on;

3. If the air velocity at each burner is kept sufficiently low to prevent loss of ignition in starting;

4. If the fuel is sufficiently rich to insure immediate ignition from the torch, and

5. If, after ignition is established, the proper mixture of fuel and air is maintained throughout the entire furnace operation, and stable ignition is maintained at all operation rates.

Similarly, after starting, explosions cannot occur:

1. If stable ignition has been attained;

2. If flame failure at a burner causes an instantaneous shutdown of fuel supply;

3. If power failure to burner equipment causes an immediate shutdown in fuel supply, and

4. If a reduction or failure in air or fuel supply causes an immediate shutdown in fuel supply control means.

Importance of Purging

Proper consideration of all factors contributing to combustion explosions, both on starting an oven and after, points to the necessity of thorough purging of the combustion chamber before lighting, and to the importance of adequate flame failure safety protection equipment.

Purging, essential where gas is used, is also necessary in connection with oil and pulverized-coal burning equipment. Oil or pulverized coal entering a combustion chamber that is hot, but below the ignition temperature, may introduce a hazard by distilling gas which, upon mixing with air, may ignite from hot refractories. There is a wider range of explosive limits where a hot furnace is slightly below the ignition temperature of the fuel, and if the fuel reaches a hot spot, a major explosion may occur with either a leaner or a richer mixture than would explode in a cold combustion chamber when first lighting off.

Purging is usually accomplished by means of an air flow switch in combination with a time delay relay that together supervise the operation of a ventilating fan. The fan may be of an exhaust type, pulling the atmosphere from the furnace for replacement with fresh air, or may blow in fresh air to dilute and eventually force out all gases that might have accumulated in the chamber.

The Combustion Safeguard

Two responsibilities are placed upon a flame-failure safety device. It must cut off the fuel supply to a burner in case of flame failure or loss of igni-

tion, and it must provide the cut-off quickly to prevent raw fuel from entering the combustion chamber after the flame failure has occurred.

Early flame-failure devices were of two general classes, both making use of heat radiated from the flame. One type employed a heat sensitive member, such as a thermostatic strip or a thermometric bulb with an expansible liquid. This member was exposed to the source of heat, and in turn operated an electric contact to energize the fuel supply valve, or it might have acted directly upon such a valve to maintain the fuel flow to the burner as long as heat was radiated from the flame to the thermally sensitive portion of the apparatus.

Another type employed a thermocouple, essentially two dissimilar metals welded together to form a junction which, upon being heated, produced an electric current flow in a low resistance magnetic valve. The valve was manually opened and maintained open while the thermo-junction was heated by radiation from the burner flame.

Objection to these early devices was that flame failure had to allow the thermally sensitive members to cool if the fuel control valves were to be closed and the fuel supply to the burner cut off. In their operation, however, sources of heat other than the flame sometimes impinged upon the thermally sensitive members and maintained the fuel supply valves open for a considerable length of time after flame failure. Radiant insulation in the combustion chamber, burning fuel that might have dripped upon the surface of the burner mounting wall, hot ceramic tips of the burner, and other factors caused such extraneous heat and reacted unfavorably upon the instrument.

The Flame as a Conductor of Electricity

To overcome these objections, the lesser known ability of a flame to conduct an electric current has been employed in a modern combustion safeguard instrument. An electrode is introduced into the flame and connected to the instrument. As a conductor of electricity, the flame has a definite range of resistance, readily distinguished from that of any other medium. The instrument reacts in accordance to the amount of resistance in its electrical circuit, of which the flame is a part. The resistance in the circuit remains within certain constant limits as long as a flame is in contact with the electrode, and the instrument holds open fuel valves in the burner fuel line and maintains combustion. Flame failure, however, increases the resistance in the circuit, and the instrument instantly closes the fuel valves to prevent flow of fuel to an unignited burner. When a burner is being ignited, a pilot light, also in the circuit and in contact with the electrode, provides the necessary resistance in the circuit to enable the instrument to open fuel lines to the burner.

For use with fuels other than gas, and which burn with luminous flames, a device incorporating a photoelectric cell is employed in place of the electrode.

Protection Extended to Instrument Failure

Modern combustion safeguard instruments, after shutting both main and pilot valves upon flame failure, provide a time delay for purging the chamber of combustible gases before lighting is permitted. They are designed for all applications where combustible gases might be present, and purging time is usually fixed at the factory to prevent tampering after the instruments have been installed.

An assurance against explosions resulting from failure of any part of a modern combustion safeguard instrument or a short in the circuit is provided, as the device then closes fuel valves as it does in case of flame failure. In this manner, the safeguard protects not only against human failure, but also against any deficiencies that might develop in the instrument itself.

Illustrated in Figure I is a hookup for gas fuel with provision made for controlled purging of the combustion chamber. No ignition attempts can be made until the air flow switch and the time delay relay indicate the combustion chamber has been purged of all combustible vapors. When purging is completed, the instrument opens the solenoid pilot valve and turns on the ignition spark. The gas from the pilot burner is ignited by the spark, and the circuit is completed when the pilot flame comes in contact with the electrode. The main solenoid valve is then opened, allowing fuel flow through the manual control valve to the main burner, where the gas is ignited by the pilot flame. After a fixed time cycle, the spark ignition and the pilot burner are shut off. If, for any reason, the pilot burner does not light, or if the main burner fails to ignite from the pilot, the instrument immediately shuts off pilot and main fuel valves and sounds the alarm. A flame failure during operation also shuts down the burners instantly, and, after a purging period determined by the instrument and set in accordance to the need of the equipment protected, causes a relight cycle.

It is unsafe to ignite one burner from the burner adjacent, especially with large capacity burners. This makes advisable use of safety equipment for guarding individual burners against flame failure. Figure II shows how a multiple-burner gas-fired oven or furnace may be equipped with combustion safeguards. Depression of the push button opens the pilot valve and energizes all spark ignition pilot burners through ignition transformers. When the pilot flames touch the flame electrodes, the instruments open the main solenoid valve and the main burners are ignited by the pilot burners. Upon flame failure at any of the burners, the main valve and pilot valve both close and the alarm bell rings.

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Finishing Warplanes

Part II.

By FRANK V. FAULHABER

The author continues the subject of warplane finishing with a discussion of the cleaning and pretreatment of aluminum.—Ed.

IT is the almost invisible film of oxide which is acquired by aluminum when it is exposed to moist air that makes it corrosion resistant. The thickness of this film governs its protective action; however, its protection is also dependent on its continuity, which in turn is affected by the alloying constituents which may be present. From various tests on different aluminum alloys made under a wide range of conditions, it is apparent that paint adheres more securely to aluminum or aluminum alloy surfaces which are most nearly passive or corrosion-resistant.

Under certain conditions, such as intermittent service in water, paint adheres more firmly to pure aluminum than to some of its alloys. Naturally the type of service the aluminum in a product is to undergo should control selection of the correct alloy. However, the corrosion resistance of the surface of aluminum can be modified and immeasurably improved by preliminary treaments especially designed for the purpose.

It cannot be overstressed that in the finishing of aluminum all traces of oil, grease, dirt, and other foreign substances should be removed. Solvent cleaning may be used for the removal of grease and grime but a completely oil-free surface ordinarily cannot be obtained by this method because grease removed by the solvent remains diluted in the solvent employed and a thin film is left by evaporation.

A better procedure is to remove films of oil and grease by treatment with solutions containing phosphoric acid and alcohol. A number of efficient cleaners of this type, which clean aluminum without materially attacking it are available. The removal of all vestiges of the cleaner by washing is vital. Also, the metal should be thoroughly dry before coating. From experiments, it is evident that such solutions, besides cleaning the aluminum surface, leave it in a passive condition as a result of the formation of insoluble aluminum phosphate. Although such a cleaning treatment is not as satisfactory as some of the oxide coating treatments, the results are adequate enough for certain purposes when done correctly.

Naturally, there are a number of advantages in achieving an impervious and non-reactive or passive film upon metal. With respect to aluminum and its alloys, an oxide film develops on the metal whenever a fresh area is exposed. Usually such a film is very slight and is vulnerable to attack by acids, alkalis, and salt solutions. An oxide film which is of substantial thickness and has impervious characteristics can be produced electrolytically on aluminum. For aluminum protected by a paint film, the thickness of the oxide coating is not as important as is the imperviousness of the film and its stability under corrosive conditions.

Oxide Films

Depending upon their development and after-treatment, oxide films upon aluminum can be porous and adsorptive or impervious to a high degree. The paint-retaining qualities of the oxide film are due not so much to its adsorptive properties as to the inert and non-reactive character of the oxide. The pores in these films are so minute that it is questionable if large micells can penetrate the coating; nevertheless, such a coating represents a superior base for the paint-coating.

Chromate solutions have a decided effect on improving and maintaining the durability of the oxide film upon aluminum without measurably increasing its thickness. This may explain the superlative results in priming when zinc chromate pigment is employed on aluminum. An adsorptive oxide coating on aluminum can be given greatly increased protective power by adsorbing chromate in the pores and decreasing the porosity. This type of coat furnishes a good base for painting. Saturated with chromate, an inert oxide coating fortifies for a minimum of chemical change of the metal surface.

In the manufacture of aircraft, anodic treatment of aluminum is widely used, since such preparatory processing makes for the most durable coatings. There are two anodic processes, one known as the chromic acid method; the other, as the sulfuric acid anodic treatment or "Alumilite" process. This latter process is an anodic

coating developed in electrolytes containing sulfuric acid, followed by special treatments which increase the protection afforded by the film. Oxide coatings developed chemically without the use of electric current are, as a rule, not as protective as the anodic oxide coatings.

Either the chromic acid or sulfuric acid treatment may be employed in so far as Army and Navy aeronautical specifications are concerned, except that the chromic acid process may not be used on parts containing more than 5% of copper, or without specific approval on parts assembled by means other than welding, and that the sulfuric acid process may not be used on assembled parts subject to stress and containing joints and recesses where the anodizing solution may be retained. Inasmuch as all anodized parts have to pass the same tests regardless of the process employed, the reason for the distinctions is undoubtedly the corrosiveness of the different solutions used.

Chromic Acid Process

The chromic acid process, with particular respect to the aircraft manufacturer's purposes, has the advantages of requiring only one treatment followed by rinsing, cooling by ordinary cooling coils only, and somewhat cheaper tank construction. The sulfuric acid treatment has the advantage of requiring a lower generator voltage.

"Corrosion tests," as specified in AN-QQ-A-696a, "shall be conducted on the anodized samples in accordance with Specification AN-QQ-S-91, except that sheet samples shall be inclined in the salt spray box at an angle of approximately six degrees from the vertical. The exposure period shall be for 250 hours. If there is any evidence of corrosive attack at the end of the 250-hour period, physical tests shall be made on both the exposed and unexposed samples. A few minute isolated pits shall not be cause for rejection, and except in cases of doubt regarding the severity of attack, physical tests on such samples will not be required. If the average of three specimens from the corrosion test samples subjected to physical tests shows a reduction in tensile strengh or reduction in elongation of more than the amounts specified herein, as compared with the values obtained on specimens taken from the unexposed duplicates, the contractor shall be promptly notified. No work processed by the contractor subsequent to the receipt of notification of failure of any test will be acceptable for aircraft use until the contractor demonstrates, to the satisfaction of the Inspector, that the necessary improvements in processing have been accomplished."

AN-QQ-S-91 requires the use of a 20% sodium chloride solution (20% by weight sodium chloride dissolved in 80% by weight water corrected with salt or water additions to a specific gravity at 60° F. of 1.151 every 24 hours). The solution shall not be used more than once. The temperature in the salt spray box shall be 95° F. ± 2° F. Other details are given in the specification.

Treatment Tank

The treatment tank forming the cathode of the circuit must be of steel. Because of the high voltage employed, it is imperative that the work be disallowed to short-circuit to the tank, which causes breakdown of the coating and pitting. For this reason the tank sides and bottom must be protected with insulating material. Acid-proof brick laid in the bottom without cement joints, and wire-reinforced glass sheets suspended around the sides with openings between them, are preferred. They do not prevent the tank from serving as cathode. Besides, they do not react with the chromic acid forming trivalent chromium as does the wood lattice-work which has been used to a considerable extent in the past.

Care should be taken with auxiliary cathodes of steel. These should be securely affixed to the tank or rack structure to prevent movement relative to and contact with the parts under treatment.

Provision should be made in the tank to agitate the solution in order to maintain the bath at an even temperature and to prevent the work from being over-heated. Compressed air is commonly used for this purpose. It is forced through the perforations in a pipe of lead or steel placed lengthwise just off the bottom of the tank.

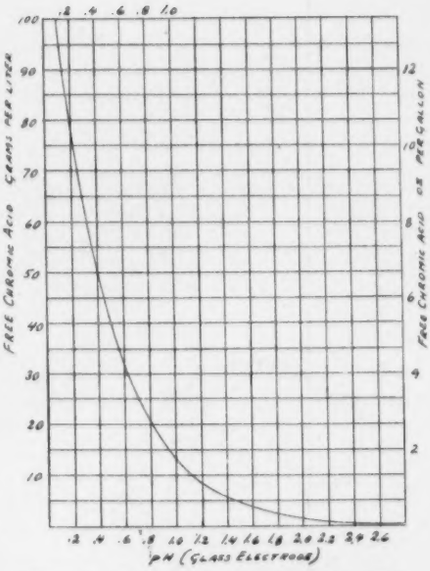

Fig. 1. Chart for Determining Free Chromic Acid from pH of Solution.

Too rapid agitation is unnecessary and is liable to cause parts and cathodes to short-circuit.

The tank should be supplied with heating and cooling means. These are ordinarily steel coils protected from short-circuiting with wire-reinforced glass. The temperature is controlled by means of an automatic regulator in the steam line. Other heating mediums may be employed as long as they can be controlled automatically.

Ventilation Needed

The chromic acid treatment tank, the alkaline cleaner tank, and the hot water rinse tank must be ventilated to remove the poisonous and corrosive fumes which are evolved. Electric current shall be provided by any direct current equipment capable of proper voltage regulation. The equipment shall have an output of 40 volts and sufficient amperage for 6-8 amperes per square foot of surface of work, plus racks. Suitable rectifiers and generators are obtainable. When computing the current capacity, attention should be given to the fact that rough, sand-blasted and machined surfaces have a larger actual surface than smooth surfaces and require more current at a given voltage.

Cleaning equipment may be of several kinds. The aluminum parts may be cleaned with an organic solvent

(*Continued on page* 116)

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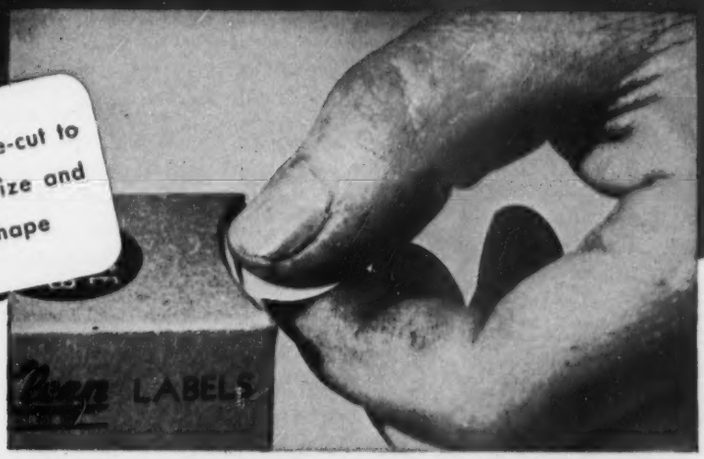

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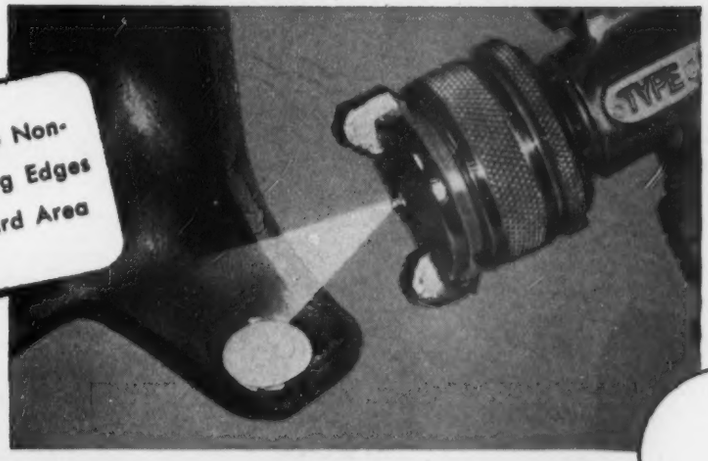

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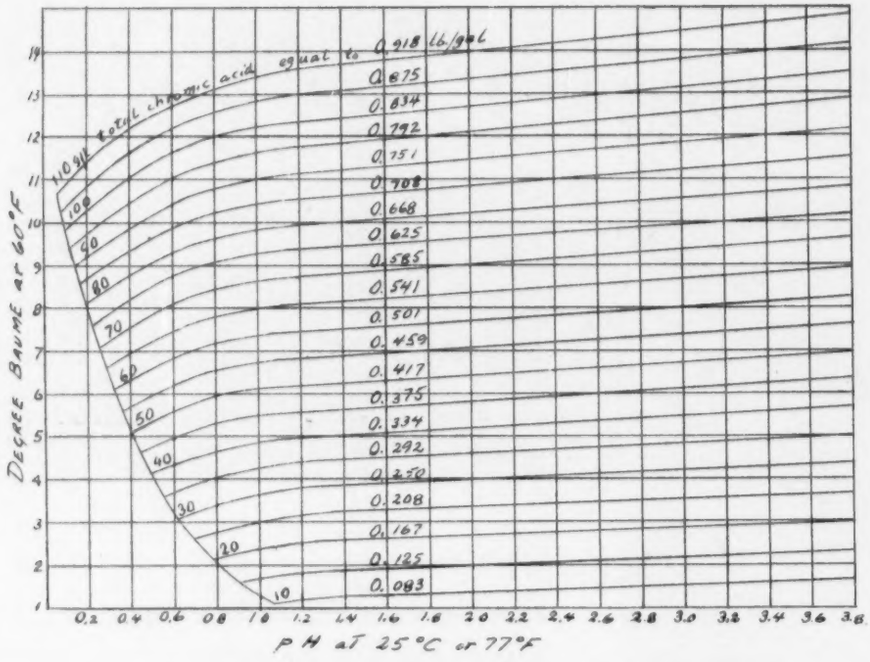

Fig. 2. Chart for Determining Total Chromic Acid from pH and Specific Gravity of Solution.

(*Continued from page* 114)

such as trichlorethylene. Free rinsing alkali cleaners, especially designed for cleaning of aluminum, are more commonly used. Castings may be cleaned by light sand-blasting or scratch brushing.

For rinsing before and sometimes after treatment, ordinary cold water rinse tanks are employed. Special consideration should be given to such parts as have been heat-treated in a salt bath. These should be rinsed thoroughly in running water immediately after heat treatment until all traces of the salt have been removed. This is done for the two-fold purpose of preventing corrosion prior to the chromic acid treatment and of preventing heat treating salts from entering the chromic acid bath.

A standard hot water rinse tank, preferably lead-lined and heated with lead coils to prevent rust from settling on the work, is used to facilitate rapid drying after treatment and cold rinsing. It should be operated at 150-185° F. Chromic acid stains are not objectionable.

Consideration also should be given to the handling of the parts through the cycle to insure absolute cleanliness and absence of finger-marks; thus the importance of painting the parts as promptly as possible following anodizing and drying. There should be no need of cleaning prior to painting. Parts unavoidably soiled should be cleaned with an organic solvent such as trichlorethylene, benzol or a paint remover free of oil or wax.

Supports

The parts should be hung on racks or wires of aluminum. Other metals such as copper or brass must not be employed since these dissolve anodically in the anodizing solution. The aluminum racks provide their own insulation. Since contact points tend to become insulated by the anodizing action, these should be cleaned between each use, either mechanically by filing or chemically in a solution of 6 oz. per gal. of caustic soda at 140-150° F. until gassing appears, or in the following solution:

Phosphoric acid (85%)	5.6 fluid oz.
Chromic acid	2.8 oz.
Water	1 gal.

This solution should be maintained near the boiling point. It has a pronounced advantage over the caustic soda solution in that the aluminum is not attacked appreciably after the oxide is removed.

Steady, high pressure contacts of 17ST or 24ST aluminum should be used in order to avoid a momentary break in contact which may cause insulation and possibly arcing and burning. The areas on the work which make contact with the racks are necessarily bare after treatment. These should be kept as small as possible.

The construction of the racks must be such that air or gas pockets are not developed to prevent formation of the film over the entire surface. Particular care should be taken with parts of intricate and irregular form.

To further eliminate human contact, racks used in hand-operated tanks may be hung from carriers which, in turn, may be handled by means of electric hoists from overhead tracks. Air hoists should be avoided, as these may cause an oil spray on the work.

Chromic acid treatment may be undertaken not only in hand-operated tanks, but also in semi and full automatic units, using special means for holding down the current surges.

Original Solution

As originally prepared, the chromic acid solution contains 2.5—10% by weight of chromic acid (3.3—13.3 oz. per gal.). Standard commercial flake chromic acid easily meets the requirements for purity set forth in the Army-Navy Specification AN-O-A-81, November 28, 1938:

	By Weight
Chromic acid, CrO_3, min.	97.70%
Sulfates, SO_4, max.	0.10 "
Chlorides, Cl, max.	0.05 "
Insoluble matter, max.	0.10 "

The 10% bath has the advantage of being the least sensitive to voltage variations. The coatings developed in this bath are heavier and therefore more corrosion resistant than those obtained in the more dilute baths, and its use has been deemed necessary to meet a 30 day salt spray requirement with 30 minutes treatment. The major drawbacks are that it uses higher current densities and consequently more current than the weaker baths, and it permits more rapid solution of the aluminum.

The 250 hour salt spray specification required by AN-QQ-A-696a can be met in 30 minutes, using a 2.5% bath maintained as follows:

The treatment bath shall be made from tap water, which, however, must be pure enough so that the resulting

solution will contain not more than 0.12 grams per liter (0.16 oz. per gal.) chloride, which is equivalent to 0.2 grams per liter sodium chloride, and not more than 0.5 grams per liter (0.067 oz. per gal.) of sulfate (SO_4) or sulfuric acid (H_2SO_4). Some hard waters and waters which have been heavily chlorine-treated may not meet these specifications. In such cases, steam condensate, if otherwise pure and free from boiler compounds, may be used for make-up and maintenance. Sulfates and chlorides in excess prevent effective anodizing by making the aluminum anodically soluble in the bath.

Chemical methods of analysis are given in the specification already referred to, AN-O-A-81.

Bath Immersion

After the work has been racked, cleaned and rinsed, it is immersed without current in the anodizing bath, which should be maintained at 95° ± 5° F. during treatment. Occasionally castings are treated at a temperature of 90° F.

Electric contacts are established at low voltage across the tank, and the tank voltage is raised gradually until 40± 1 volt has been reached. Each increase in voltage causes a surge of current, the magnitude of which depends on the magnitude of the voltage increase. Consequently, in order to prevent the maximum surge current from increasing above the current capacity of the generating equipment, the rate with which the voltage is increased must be kept down. Inasmuch as the voltage increase is stepwise, sufficient time should be permitted between each voltage step to permit the surge current to drop to a value fairly close to the "steady state" operating current density.

Usually the capacity of the current generating equipment is selected so as to permit a maximum surge of 6-8 amperes per square foot of actual surface. The actual surface is considered equal to the surface of smooth, cold, rolled sheet aluminum, and may be twice that of the apparent surface of rough cast surfaces or shot blasted surfaces.

Ordinarily, the steady state operating current density varies between 1 and 3 amperes per square foot, depending on the amount of free chromic acid content and the temperature of the bath, an increase of which causes an increase of the current density. It also depends on the composition of the aluminum alloy. Hence, at 95° F. and a pH of 0.9, the steady state current density is about 2.0 amperes per square foot on Alclad 24ST, 1.5 on Alloy 24ST and 1.05 on Alloy 17ST. At a pH of 0.6 these values are 2.3, 1.9 and 1.5 respectively, and at a pH of 1.2 they are 1.2, 1.3 and 0.9 respectively.

Voltage Rate

The rate of the voltage increase usually is 5—10 volts per minute, which gives a voltage raising period of 8—4 minutes. Of course, sometimes it is possible to raise the voltage more quickly, but then there is a temporary depression of the steady state current. After a little while the current rises towards its true steady state value. The voltage drops with it to below 40 volts and has to be brought back to this specified value. As an alternative, the finishing operators may arrange to raise the voltage initially to somewhat more than 40 volts so that the true steady state voltage becomes 40 volts.

(*Continued on page* 118)

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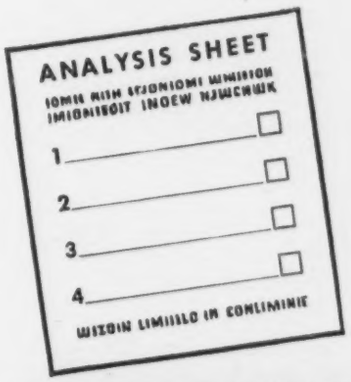

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(*Continued from page* 117)

Specification AN-QQ-A-696a does not call for any specific treatment time, only for certain salt spray resistance. However, 30 minutes is ordinarily chosen. All surfaces must be treated at 40 volts at least 30 minutes according to PT-19 and for at least 60 minutes according to P. S. No. 624.

The effect of temperature is shown in the thickness of the anodizing film produced. Tests with Alclad 24ST treated for 60 minutes at 40 volts, show thicknesses of 0.00006, 0.00010 and 0.00014 in. at pH of 0.8 and at 80, 95 and 110° F., respectively. At pH = 1.2, the corresponding thicknesses are 0.00005, 0.00006 and 0.00010 in. Ordinarily, coatings 0.00002 in. thick will meet the salt spray test requirements. It is noteworthy that high temperature causes an increase in the steady state current and a decrease in efficiency because of the increased solvent action on already formed aluminum oxide.

Special consideration is required in the treatment of alloys containing 4% or more of silicon. Since the silicon constituent is non-film-forming, an excessive current flow is thus encountered, causing "burning" of the article. The starting voltage increase should be slow and it may be necessary to limit the final operating voltage to a value below 40 volts. Usually no advantage is attained by treating high silicon alloys for more than 10 minutes.

Separate Processing

Invariably high silicon alloys should be processed separately. Other alloys would draw less current than calculated and necessary for the formation of the film, when present in the tank concurrently, and the silicon-high alloys would draw too much current and become burnt. Evidence of porosity and surface etching at or near welds is indicative of improper welding practice.

The treatment bath, under maintenance, has two primary objects, namely:

1. To insure the presence of sufficient free chromic acid available for anodizing in the bath.

2. To control the concentrations of chloride and sulfate which, when present in sufficient concentration, prevent the anodizing.

The chromic acid is consumed in several ways. It is adsorbed by the oxide film on the surface of the work. It is lost by drag-out and in the spray which is removed by the ventilating equipment. Also, chromic acid is reduced to trivalent chromium on the cathode surface, particularly at low current densities, and by organic dust and dirt entering the bath. Under normal conditions, when the tank is well-filled with work and the anode current density is low, sufficient re-oxidation takes place on the surface of the work to prevent undue accumulation of trivalent chromium. An excess of trivalent chromium may be oxidized to chromic acid by electrolysis at a low voltage, using an anode area of lead equal to the cathode area. To be effective, this lead has to be coated with a purple to black coating of lead peroxide.

Chlorides and Sulfates

In an earlier paragraph the effect of chlorides and sulfates was mentioned. The solution level must be maintained with water low in chloride and sulfate. Chlorates may be removed by electrolysis at the same time as

trivalent chromium is oxidized to hexavalent chromium with a lead anode. Several methods of control of the free chromic acid content have been suggested, most of which are deficient in one or more respects. Those following appear to be more satisfactory. They provide means to determine not only the free, uncombined chromic acid content, but also to estimate the amount of aluminum present in the bath or the combined chromate.

The finishing operators need not usually be concerned with respect to the aluminum content until aluminum chromate crystallizes out in the bath. A critical concentration of chloride or sulfate is liable to be reached before this happens. When the aluminum, the chloride or the sulfate content becomes too high, the bath should be discarded and a fresh bath prepared.

It is recommended that the bath be made up to contain 2½% or 3.3 ounces per gallon chromic acid. Such a solution has a pH of 0.68. It is used without additions until the pH has risen to 0.8-0.9 = 2-1:5% or 2.7-2.0 ounces per gallon free chromic acid. The pH is maintained in this range from then on with additions of chromic acid. When the total chromic acid content reaches 10% (13.3 ounces per gallon) it is not allowed to increase any further. Instead, portions of the bath are discarded at intervals before the next addition of chromic acid is made. By this procedure the aluminum content never reaches too high a value and ordinarily the bath need never be dumped.

Analysis Requirements

Analysis for Free Chromic Acid and Aluminum:

This method requires use of a glass cathode pH meter. The operator also needs a stirrer and a burette with stand and a 1.00 N standard sodium hydroxide solution. The procedure is as follows:

1. Pipette 25 ml. of the anodizing solution into a 250 ml. beaker and dilute with 75 ml. distilled water.

2. Immerse the electrodes and a fairly slow stirrer in the beaker.

3. Stirring continuously, titrate with the standard 1.00 N sodium hydroxide solution.

4. Record the number of ml. necessary to bring the pH first to 3.2 and then to 4.8. Add the sodium hydroxide very slowly when these pH values are approached, since very small additions cause large pH changes at these points.

5. Calculate the composition of the bath as follows:

If A = ml. sodium hydroxide added to give pH = 3.2
B = ml. sodium hydroxide added to give pH = 4.8
N = normality of the sodium hydroxide
Free chromic acid, CrO_3 in % = 0.4 x A x N
Free chromic acid, CrO_3 in g./L. = 4 x A x N
Free chromic acid, CrO_3 in oz./gal. = .534 x A x N
Alumina, Al_2O_3 in g./L. = 6.8 x B x N — 6.94 x A x N
Alumina, Al_2O_3 in oz./gal. = .91 x B x N — .93 x A x N

Analysis of Free and Total Chromic Acid:

This method requires use of a glass electrode pH meter and the free chromic acid is computed directly from the pH, using chart 1.

The total chromic acid content, including the free and combined chromic acid, may be had from a combination of the °Baume and the pH, using chart 2.

Notes:

1. Always keep the glass electrode in water when not in use.

2. Check the accuracy of the pH meter against a solution of known chromic acid content and correct for any discrepancy.

Other Procedures

Analysis for Chloride:

1. Pipette 25 ml. of the anodizing solution into a 250 ml. beaker.

2. Add about 75 ml. of distilled water and about 50 ml. of concentrated nitric acid.

3. Warm the solution to 50°C. (122° F.)

4. Add drop by drop 5 drops of a silver nitrate solution containing 100 g./L. $AgNO_3$ (Keep in dark bottle).

5. Stir with a glass rod and allow the precipitate to settle *in the dark*.

6. Filter on a weighed crucible.

7. Wash first with water containing a little nitric acid, then twice with alcohol.

8. Dry in oven at 105° C. (220° F.), cool in dessicator and reweigh.

9. Calculate the chloride content as follows:
% chlorine (Cl) = weight of silver chloride in grams.

Analysis for Sulfate:

1. Pipette a 25 ml. sample into a 500 ml. beaker.

2. Add about 50 ml. distilled water, 25 ml. concentrated hydrochloric acid and 50 ml. methyl alcohol.

3. Boil for 5 minutes or until the solution turns green or blue.

4. Add 75 ml. glacial acetic acid and boil for 10 minutes.

5. Dilute with 100 ml. distilled water and add drop by drop with stirring 10 ml. barium chloride solution, containing 100 g./L. crystalline barium chloride, before the solution cools below 70° C. (160° F.)

6. Allow to stand for 1 hour in a constant temperature water bath or oven kept at 65° C. (150° F.)

7. Add quickly a dozen drops of filter paper suspension and filter at once into a 500 ml. beaker through a Whatman #42 filter paper or equivalent. Wash with hot water until the last drops of the filtrate show no cloudiness when dropped into a silver nitrate solution.

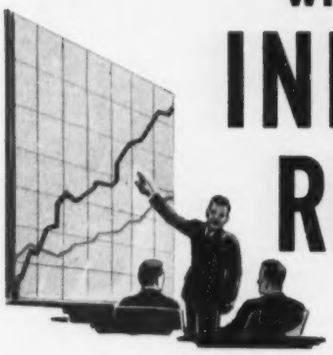
8. Transfer paper and precipitate to a weighed porcelain crucible, burn off the paper slowly, finally igniting to a bright heat for 15 minutes.

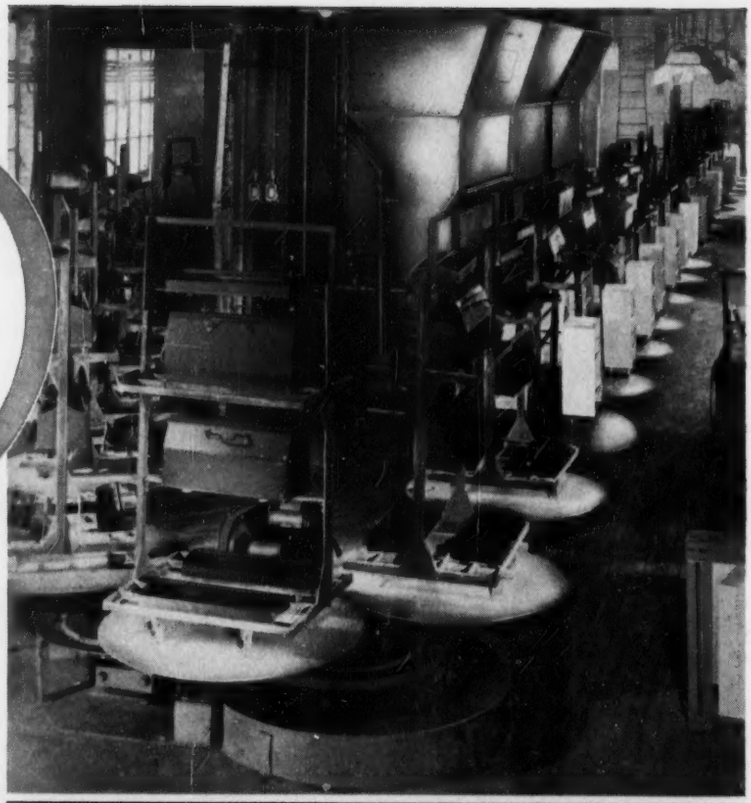
9. Cool in desiccator and reweigh the crucible.

10. Calculate the sulfate content as follows:
% sulfate (SO_4) = 1.64 x weight of barium sulfate in grams.

(To be Concluded)

Step Ahead WITH INFRA-RED





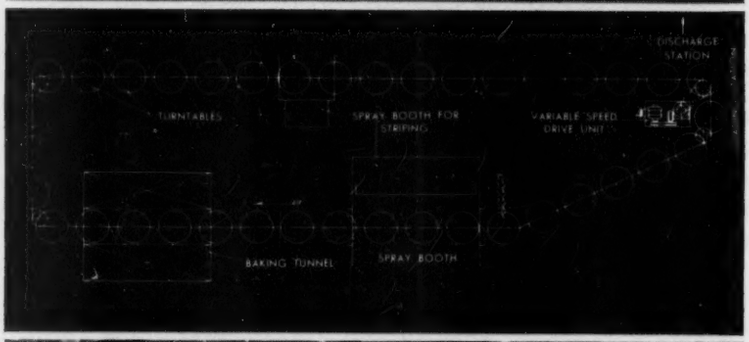
Here is a typical case study of a Gifford-Wood Infra-Red finish-baking and drying system to help a manufacturer turn out products needed to win the war.

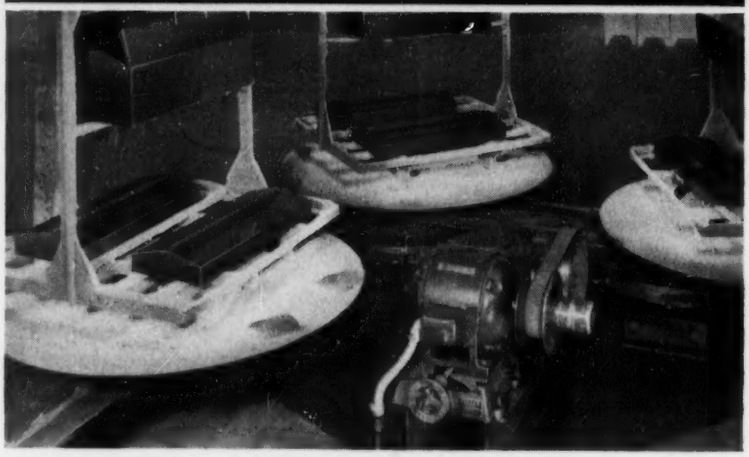
E. J. McAleer & Co., Philadelphia, manufacturers of fabricated metal products changed from convection ovens to a modern Gifford-Wood Infra-Red baking and drying system, complete with conveyors to handle the products. Here are results:

	Ovens	Infra-Red
Space occupied	10,000 sq. ft.	**5000 sq. ft.**
Number employees	12 men	**6 men**
Baking time	45 minutes	**10¼ minutes**
Cooling time	20 minutes	**18 minutes**

OTHER GAINS

Rejects reduced 30%. Electric current costs 1/3 less than oven fuel formerly consumed. Paint cost reduced. Insurance costs lowered. Maintenance costs slashed.





The entire system and equipment were designed and installed by Gifford-Wood. This is but one of many G-W installations that have solved war problems such as man shortage, space limitations, production increase. All of these objectives are achieved — and economy too.

If you are still oven-baking and drying finishes on metal products, or air-drying them, step ahead with infra-red. Gifford-Wood will show you how. As a first step write for Bulletin 0-150.

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HEADQUARTERS FOR INFRA-RED BAKING AND DRYING

3656

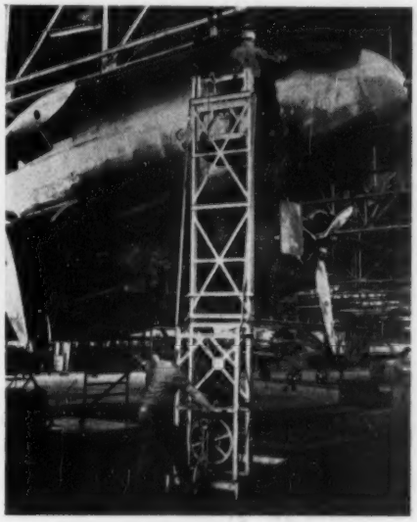
Finishing Lifters and Telescopers at Economy Engineering Company

By H. DEUTSCHER

Superintendent, Economy Engineering Company, Chicago

THE Economy Engineering Company has solved its painting problem by simplification. The products of the company, which include portable elevators, loom beam trucks, Hi-Reach telescopers (some of which reach to a height of something like 75 ft.), mechanical lifters (some manually operated and others powered, used for stacking, loading, and unloading), shop lifters (for handling heavy dies into and out of presses, and for other purposes in and around the shop in industrial plants), carboy tilters, Red Rocker barrel stands, and shovel trucks, all enjoy wide distribution throughout the country. The products are of welded construction, mostly of channels and angles.

As the units are completed, they are moved to the paint spray booth in one corner of the plant, where the portable elevators and telescopers, as well as the loom beam trucks, are given a spray coat of olive green enamel,—self-contained hoisting units, controls, and motors having previously been masked. After an overnight drying period the masks are removed; the hoisting unit and hinge locks are touched up with red enamel wherever necessary; motors and control are touched up in black enamel. The word "Economy" is then applied to the side and cross bars of the portable elevators by means of decalcomania transfers; one also is applied to the Red Rocker barrel stands after painting has been completed.



Hi-Reach Lifter as Used in Aviation Plants

The back and front heads of cases for the hoisting unit are delivered to the plant for machining, after which they are thoroughly washed with a commercial cleaning solution, dried, and the inside surfaces given a brush coat of transmission red to prevent any scaling after the assembly of the gear mechanism. When assembly is completed the outside of the case is sprayed with red enamel.

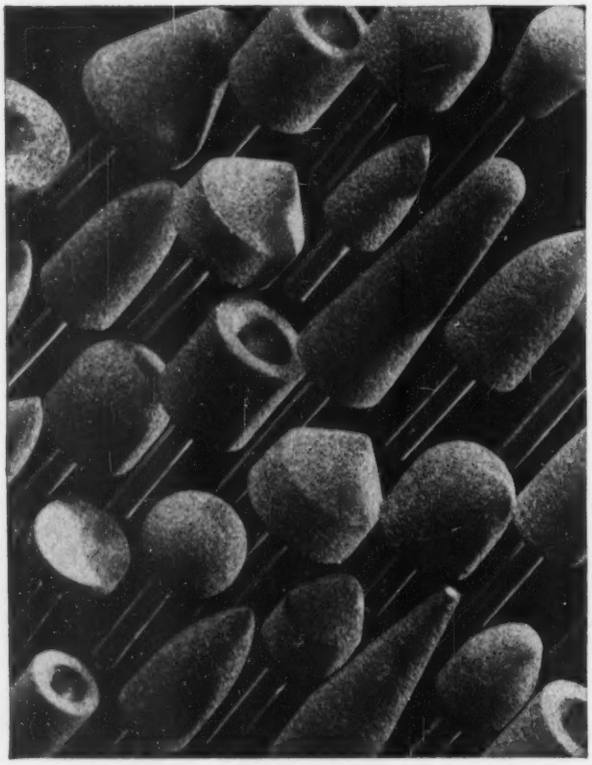
Red Rocker barrel stands, shovel trucks, and carboy tilters, also of welded construction, are delivered to the spray booth in groups and given a single coat of red enamel.

Barrel storage racks, consisting of panels and skid bars, with tie rods at intersection points, are all painted with black asphaltum. This is applied by dipping the parts into a tank erected outside the building at the rear of the plant. This tank, about 12 ft. long by 18 in. wide, is 10 ft. deep and is filled with about 9 ft. of water on the surface of which floats about 6 to 8 in. of black asphaltum. The panels are handled by an overhead hoisting equipment and are lowered into the tank (through the asphaltum and into the water and out again through the asphaltum). As they go down they get a coat of the paint, the water not affecting the coat in any way, and as they are brought up, they receive a second coat as they pass through the floating asphaltum. About four hours is allowed for drying after dipping. The skid bars are handled in the same way, while the tie rods, made of round mild steel and threaded at one end, are tied in bundles of a dozen (the threaded ends being wrapped in burlap so that in the dipping process the threads are not affected by the paint).

Dipping Tank in Operation

The spray booth has a large exhaust fan and carries the fumes to the outside atmosphere. Five-gallon pressure tanks are used for spraying with about 30 pounds of pressure supplied by a portable unit.

Carry On



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PEARL ESSENCE

Pearl essence is finding wide use in the finishing industry today. In this article the manufacture of pearl essence is described and instructions concerning its use in finishing materials are given. The information contained in the article should be of considerable interest and value to those who wish to obtain metallescent effects in finishes.—Ed.

GENUINE pearl essence, which is being used more and more extensively in all lines of manufacturing where a beautiful pearl finish is desired, is technically known as pure crystalline quanin. Under a microscope the particles which make up this quanin are minute crystalloids of a refracting nature. They seem like thin rectangular-shaped blades, transparent in appearance; yet the clean flat surfaces of these crystalloids throw flashes of light in different directions. They are very fragile, and when broken or reduced in size, lose most of their brilliancy.

These crystalloids, or crystals, which make up the quanin and which collectively are known as pearl essence, can be derived from many sources, but for present commercial purposes they are mainly extracted from certain types of fish scales—such as herring, shad, pilchard, etc. A close examination of the scale containing these brilliant particles shows that the pearly appearance is due to crystalloids in the midst of epithelial cells, which form the inner layer of the scale, i.e., the side of the scale nearest the body of the fish. These crystalloids are apparently deposits emanating from the internal organs of the fish. They serve as a protection of nature in the form of camouflage, by reflecting lights and colors, to blend either with the sky when seen from below, or with the color of the water when seen from above.

In order to make pearl essence, these films containing the crystalloids and foreign matter must be removed from the scales, as, contrary to the general belief, the transparent, bony part of the scale is not ground up nor used in any way in the manufacture of genuine pearl essence. In fact not only must this bony part be removed, but all foreign matter, such as oils, fats, protoplasmic matter, slime, etc., must also be separated from the crystalloids to make the best quality pearl essence. If they are not properly separated, decay will quickly set in, and eventually destroy and discolor the essence, and prove troublesome to the user.

Until quite recently, the only known and generally practiced method of making pearl essence was one that had been in use for hundreds of years. This method was very unsatisfactory, of long duration, and frequently, if not generally, attended by great losses because of putrefaction, or breaking up of the delicate crystalloids by the constant handling, etc. necessitated by the process. This made the price exorbitantly high, and together with the fact that at best the quality was only fair as today's standards go, tended to restrict the field for the use of pearl essence.

New Production Methods

After many years of intensified study and experience, a Frenchman developed a new method to produce pearl essence—a method that was revolutionary in its conception and in the results obtained. This process permitted complete control over large scale production; it enabled doing in a few hours what previously took months; it avoided losses through putrefaction, etc., and it turned out a product superior to anything that could be made by any other known method.

By these processes production costs were drastically reduced; at the same time, the producing of a material having constant uniformity of cleanliness, quality and concentration was assured.

For these new methods special mechanical equipment is used extensively. The scales are obtained from whatever source possible, in as clean a condition as possible. If they are not clean, they are washed with water, with the minimum amount of agitation, to free them of the slime, etc. They are then put into churns with water and special detersive agents, which do not destroy the crystalloids, and which leave no after residue in the essence. After churning for sufficient time to remove the film containing the crystalloids from the bony part of the scale, the mass is strained to separate the pearly liquid from the scales and foreign matter. This liquid is then put through rapidly rotating centrifugal separators to eliminate the dirty water, floating fat, etc. The partially dehydrated paste is then subjected to further treatment and cleansing by special detersives, reduced to liquid form, and once again put through the centrifugal machine. The material that remains in the centrifugals is then incorporated into a specially prepared liquid, or a special lacquer-like substance, and subjected to a washing process which removes the remaining foreign matter that is of the same specific gravity as the pure essence crystals themselves. This foreign matter could not be thoroughly eliminated in any other way.

Mixing Pearl Essence

Pearl essence lacquers are made by incorporating the concentrated pearl essence with a clear lacquer. Put the pearl essence in a receptacle and add the lacquer to it gradually, stirring continuously until a homogeneous solution is obtained.

For general industrial purposes, it is recommended that

(This article was prepared with the aid of Paispearl Products, Inc., 65 Nassau Street, New York, N. Y.)

5 ounces of the concentrated pearl essence be used to each gallon of clear lacquer in form ready for use, either for dipping or spraying. Should this solution prove too concentrated, it may be reduced by adding regular high grade thinner, such as is generally used in conjunction with such lacquers. Should a heavier concentration be desired, put additional concentrated pearl essence to the gallon of lacquer. Do not use more than 8 ounces of pearl essence per gallon as to do so would be to waste the material without getting the most efficient and economical results.

As pigmented lacquers are more durable than clear lacquers, so also will pearl lacquers be more durable if they have pigments added to them. A limited quantity of colored lacquer of the desired shade may be added directly to the natural pearl solution, made as mentioned above, without affecting its brilliancy. The opacity of the color pigment tends to offset the pearl effect as the quantity color is increased. Consequently it is desirable and more economical to use only the most brilliant and purest quality of pearl essence in colored solutions.

While the amount of colored lacquers to be added will vary, depending on the color used, for general industrial purposes, it is recommended not to exceed the proportions of one-half pint of standard colored lacquer to three quarts of natural pearl solution. The shade may be lightened by a lesser amount of the colored lacquer. Be sure that the colored lacquer so added is well stirred, so that the colors will be thoroughly mixed.

Should thinners be used with these solutions, be sure that the best grade of thinners are used. Do not use thinners that are too fast drying, as they tend to prevent the proper orientation of the crystals, and thus dim the smooth pearl finish.

As a precaution before using, the solution should be strained, preferably through 80 mesh screen, to prevent lint and other impurities from passing through. Constant care must be exercised to keep the solution free from dust or foreign substances by keeping the containers and the spraying apparatus thoroughly clean.

Application

The application of pearl essence lacquers is governed to a considerable extent by the products on which the pearl finish is to go, and the exposure, or general wear and tear on that article or product.

Prepare the object to be coated in the same way as you would if ordinary pigment lacquer coats were to be applied.

Dipping operations produce the best results, because the flow of the solution enables the crystalloids to orient themselves flat surface up, thus giving the best pearl effect with a smooth finish and the minimum amount of material. As dipping operations are not generally commercially practicable, spraying operations are used.

For general spraying purposes, it is recommended to use not more than 40 pounds pressure in the gun, keeping the nozzle of the gun about 10 inches from the object being coated. Move the gun with a short fanning movement and keep the laps closer together than in spraying ordinary lacquers. This will avoid streaks or unevennesses in the finish. Be sure that a moist float (*but not flowing*) coat is obtained after spraying with a pearl solution, so as to permit the proper orientation of the crystals with the attendant smooth and brilliant pearl finish. If the solution is applied too dry, a coarse, granular or pebbly finish, lacking in proper sheen will be obtained and the depth of finish will be lost.

If primers or regular pigmented lacquer undercoats are used on the product before applying the pearl solution, be sure that sufficient coats have been used to give proper hiding. Be sure also, that these undercoats are absolutely smooth before applying the pearl.

If the natural pearl solution is used over undercoats of color, the hue of the undercoat will be transparently visible through the pearl coats in a softer and subdued tone. This is brought about by the fact that the pearl solution in itself is transparent, and not opaque. Consequently, interesting two-tone effects can be obtained by applying different colors one on top of the other.

Sometimes it is advisable to sand the undercoats to give the desired smoothness. In such cases it is recommended to use No. 400 Wet or Dry paper, wet with naphtha, and sand very lightly, using a circular motion. Do not use parallel longitudinal strokes as these tend to produce streaks. Wipe the surface clean after sanding.

Allow about 20 to 30 minutes between coats for proper drying.

Facts About Pearl Essence

The incorporation of essence, properly made into lacquers, not only embellishes the articles to which this pearl lacquer is applied but at the same time increases the durability of the lacquer because of the reflection of light, and because it makes a tougher coat without affecting its pliability.

An excess of pearl essence crystals in the solution, when applied over colors, gives a silvery sheen instead of the pearly effect desired; consequently, it gives an opaque surface instead of a translucent film. The best results with the greatest depth of color are obtained by using several coats with a small amount of pearl crystals in them.

Furthermore, genuine pearl essence is non-toxic and non-corrosive when it comes in contact with metal; it does not discolor when exposed to light, and it will retain its brilliancy indefinitely.

Irregular or curved surfaces bring out the pearly effects more strikingly than do flat surfaces.

Pearl essence may be reclaimed easily and inexpensively, and may be used over again with satisfactory results. This represents not only a saving in the cost of raw material but also in the cost of production of the finished article.

To save and reclaim the unused pearl essence, put a sheet of cellophane in the spray booth so as to catch the solution that ordinarily goes past the object being coated in spraying operations. The accumulations of pearl solution on the sheet of cellophane may be washed off by soaking in acetone. The cellophane sheet, freed of the pearl solution, is then withdrawn, and ready for use again. The material washed off is reduced still further by additional acetone to permit ordinary sedimentation operations. By this method the pearl crystals are easily extracted from the lacquer and heavy foreign matter, and may then be added in that form to clear lacquer and used again in the usual way. This reclamation process may be repeated as often as necessary until all the pearl essence has been used.

New Equipment

Plastic Spray Gun Bodies

After many months of development and test, the Eclipse Air Brush Company, 400 Park Avenue, Newark, N. J., presents its spray guns with plastic bodies. The new black plastic gun weighs a quarter of a pound less than the spray gun with aluminum body that it replaces. The lighter weight is an important factor in reducing fatigue.

The plastic is said to have good chemical resistance and not to be affected by thinners, solvents, paint removers, etc. It is also claimed to have impact strength.

Priority assistance is still required to obtain the guns, but delivery is good.

Spray Gun With Plastic Body

New Electric Sander

Sterling Tool Product Co., 363 E. Ohio St., Chicago, Ill., manufacturers of portable oscillating sanding machines, have announced the new "Sterling 1000" electric sander designed and built for heavy duty service.

The machine comprises a streamlined balanced and counterbalanced vibrationless unit, is compact in size and has a handle designed to comfortably fit the hand of either men or women operators with a snap action switch located conveniently to the operator's thumb.

It is powered by a 1/5 H.P. Universal motor cooled by a turbine-type fan. The motor is protected from dust by a replaceable filter screen.

The gears and counterpoise mechanism are sealed in a dust-proof cartridge-type gear case. Moving parts are supported by oversize ball and needle type, plus 1 sintered bronze bearing.

A detachable sanding pad operated by a simple latch-type lock takes 1/3 sheet of standard abrasives and is made flexible to permit sanding on curved or flat surfaces. Tumbler action clamps operated by key, screwdriver, etc., lock abrasive sheets on the pad.

Business News

Grover M. Hermann

Grover M. Hermann, president of the *American-Marietta Co.*, announced that his company had recently acquired *The Ferbert-Schorndorfer Co.*, of Cleveland, O. Mr. Hermann emphasized that it will be operated as a subsidiary with no change in its present management.

David Andrew, who has been with The Ferbert-Schorndorfer Company since 1930, will continue as its president. *Guy Bartholomew*, with the company since its inception in 1922, has been elected vice-president. Mr. Hermann has been elected chairman of the board of directors.

The acquisition of this company brings the American-Marietta Company a substantial increase in their sales of metal finishes and gives complete diversification to their popular paint line.

Patents

Organic Coating

U. S. Pat. 2,307,783. C. J. Malin & G. J. Clarke, assignors to Eastman Kodak Co., Jan. 12, 1943. A method of applying a strongly-adhering coating to the surface of a metal object which is not affected by moderate heat which comprises wetting the surface to be coated with a solution in a volatile solvent of a cellulose ester selected from the group consisting of the cellulose acetate butyrates and the cellulose acetate caproates having melting points of less than 230°C. and char points at least 40°C. above their respective melting points, which ester contains 0-20% of plasticizer and is substantially free of resin, evaporating off the solvent and subjecting the object having a layer of the cellulose ester thereon to a temperature which will melt the ester without detrimentally affecting it and then allowing the coating to cool so that a strongly adherent, firm, nontacky coating results.

Organic Coating

U. S. Pat. 2,307,861. C. L. Shapiro, assignor by mesne assignments to Atlas Powder Co., Jan. 12, 1943. A method of making a coated article which comprises providing a metal base, applying to said base a primer coating consisting essentially of a mixture of a fatty acid glyceride, asphaltum and a small amount of nitric acid, the fatty acid glyceride comprising approximately 70% of the mixture, baking the primer to such a degree that the surface of the coating is nonadherent, applying to the primer surface a coating having as its essential element a vinyl acetate-vinyl chloride copolymer and baking said latter coating.

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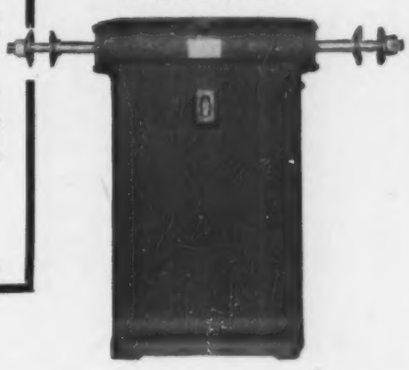

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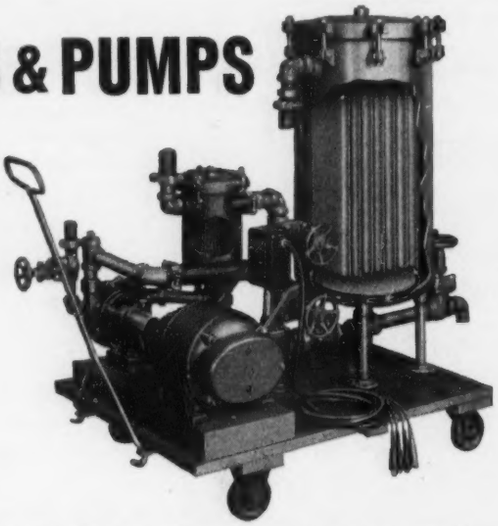

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Shop Problem

Problem 6. Sprayer Efficiency

Problem: A sprayer, using a spray gun adjusted to deliver 6.0 gallons of air dry lacquer per hour when kept wide open, actually uses 3.2 gallons of lacquer per hour. The lacquer contains 1.2 pounds of non-volatile film-forming solids per gallon. Production data show that the sprayer finishes an average of 58 units per hour. If the weight of dry lacquer on each finished piece is 0.04 pound, what is (a) the time efficiency of the sprayer; (b) his material efficiency, and (c) his overall efficiency.

Solution: Since the gun can deliver 6.0 gallons of lacquer and the sprayer actually sprays only 3.2 gallons of lacquer per hour, the sprayer is not actually spraying for the whole hour and his time efficiency is $\frac{3.2}{6.0} \times 100 =$ 53.3 per cent.

According to the data, the sprayer sprays $3.2 \times 1.2 = 3.84$ pounds of solids. Since each finished piece requires 0.04 pound of solids, it is theoretically possible to finish $\frac{3.84}{0.04} =$ 96 units with this amount of material. However, the sprayer actually sprays only 58 units and, therefore, his material efficiency is $\frac{58}{96} \times 100 = 60.4$ per cent.

If the gun were kept wide open for the whole hour and if there were no loss of material in overspray, etc., it would be possible for the sprayer to produce $\frac{6.0 \times 1.2}{0.04} = 180$ units per hour. He actually produces 58 units per hour. Therefore, his overall efficiency is $\frac{58}{180} \times 100 = 32.2$ per cent.

The overall efficiency may also be obtained by multiplying the time efficiency by the material efficiency, thus: $53.3 \times 60.4 = 32.2$ per cent.

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Sparkler filtration for nickel, copper, cyanide, brass, zinc, cadmium, silver, chromium, etc., with its exclusive horizontal plate feature, is effected with streamlined units which operate smoothly and efficiently—and at greater flow rates. Mobile filters that utilize every kind of filter aid, doing work that is uniform and always of the highest quality.

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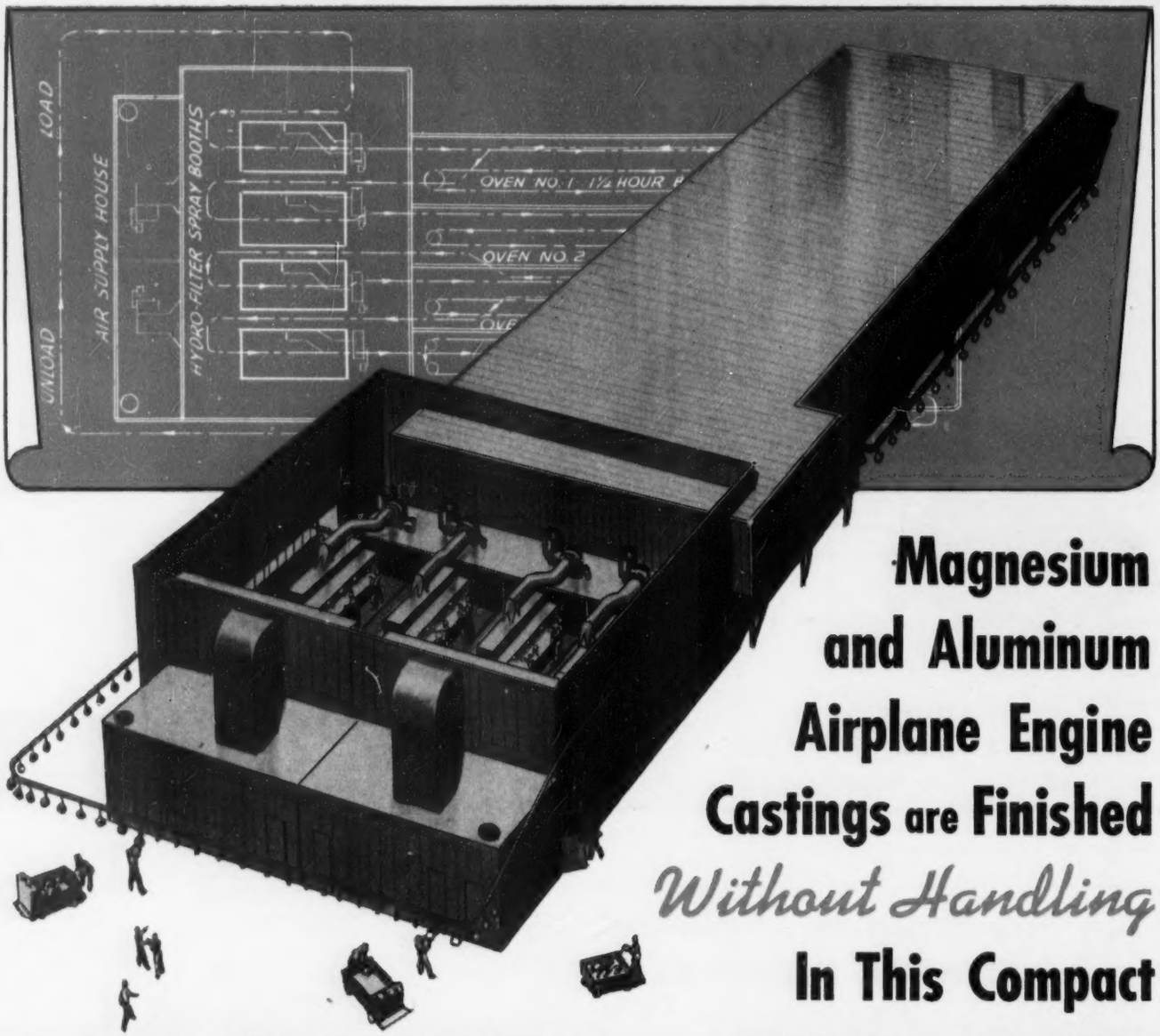

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This installation handles a vast volume of production smoothly and speedily—yet, so compactly has it been designed, it occupies a remarkably small floor area. Every phase of operation—conveying, filtered air supply, fume removal, heat control, cooling—is *automatic*. Except for loading and unloading of conveyor lines and for spray painting operations, manpower has been entirely eliminated.

Throughout the aircraft industry—and in many other fields of war production—Mahon *processing* and *finishing* equipment is constantly being created and utilized to keep production rolling on a faster and more economical basis. If a problem exists in your plant—consult Mahon engineers.

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MAHON

Supply Prices, January 25, 1943

Anodes

Prices are f.o.b. shipping point on quantities of from 500-999 lbs. for copper, brass and zinc. For nickel, prices are for quantities from 500-2,999 lbs.

COPPER: Cast, elliptical, 15" and longer	25½c. per lb.	ZINC: Cast, 99.99, 16" and over	16¼c. per lb.
Electrolytic, full size, 22⅞c; cut to size	22⅞c. per lb.	NICKEL: 95-97 cast, elliptical 46c. per lb., 99% plus cast 47c.; rolled, depolarized	49c. per lb.
Rolled, oval, straight 15" and longer 23¼c. per lb.; curved	24¼c. per lb.	SILVER: Rolled, .999 fine per Troy (1-9) oz.	58c. per oz.
BRASS: Cast, 80-20, elliptical, 15" and longer	23⅝c. per lb.		

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, C.P., drums, l.c.l.	lb.	.09
Acid, Boric tech., 99.5% gran., bbls.	lb.	.0635
Chromic, 99%, 100 lb. drums, l.c.l.	lb.	.1725-.1825
Hydrochloric (muriatic) tech., 20°, carboys, wks	lb.	.027
Hydrochloric (muriatic) tech., 22°, carboys, wks	lb.	.19
Hydrofluoric, 30% bbls.	lb.	.06
Nitric, 36°, carboys 1-9, wks.	lb.	.0595
Nitric, 42°, carboys 1-9, wks.	lb.	.0745
Oleic (Red Oil), distilled, drums	lb.	.1225-.1325
Oxalic, bbls. l.c.l.	lb.	.125
Stearic, distilled, double pressed, bags	lb.	.14-.15
single pressed, bags	lb.	.135-.145
triple pressed, bags	lb.	.17-.18
Sulphuric, 66°, carboys 1-9, wks.	lb.	.0245
Alcohol, Amyl (Fusel oil, ref'd), l.c.l., drums	lb.	.151
Butyl-normal, l.c.l., drums	lb.	.1225-.1575
Denat., S.D. #1, 190 pf., 1-18 drms., wks.	gal.	.615
Diacetone, tech., drums, l.c.l.	lb.	.115-.14
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.37
Propyl-Iso, 99%, drums, l.c.l.	gal.	.47
Propyl-Normal, drums, wks.	gal.	.67-.70
Alum, ammonia, granular, bbls., works	lb.	.04
Potash, granular, bbls., works	lb.	.0425
Ammonia, aqua, 26°, carboys	lb.	.0525
Ammonium, chloride (sal-ammoniac), white, granular, bbls., wks.	lb.	.0515
Sulphocyanide (thiocyanate), pure, crystal, dms.	lb.	.45-.55
Sulphocyanide (thiocyanate) 95/98%, tech., dms.	lb.	.15-.18
Antimony Chloride (butter of antimony), sol., carboys	lb.	.17
Barium Carbonate, pptd., bags, l.c.l., works	lb.	.03
Benzene (Benzol), 90%, drums, works	gal.	.20
Butyl Lactate, drums	lb.	.265
Cadmium Oxide, l.c.l., bbls.	lb.	.95
Calcium Carbonate (Pptd. chalk), c.l., wks.	ton	$40.00
Carbon Bisulphide, l.c.l., 55 gal. drums	lb.	.0575
Carbon Tetrachloride, l.c.l., drums	gal.	.80
Cobalt Sulphate, drums	lb.	.65
Copper, Acetate (verdigris), bbls.	lb.	.26-.35
Carbonate, 52-54%, bbls.	lb.	.195-.205
Cyanide, Tech., 100 lb. bbls.	lb.	.34-.38
Sulphate, 99%, crystals, bbls., 1-5	lb.	.0565
Cream of Tartar (potassium bitartrate), gran., kegs	lb.	.585
Crocus Martis (iron oxide) red, bbls.	lb.	.09
Dextrin, white, bags, F.O.B. Chicago	lb.	.0415
Dibutyl Phthalate, drums, l.c.l.	lb.	.205-212
Diethylene Glycol, drums, l.c.l., works	lb.	.155
Emery (Turkish)	lb.	.08
Ethyl Acetate, 85%, l.c.l., drums, works	lb.	.1220-.125
Ethylene Glycol, l.c.l., drums, works	lb.	.165
Monoethyl ether, dms., l.c.l., wks.	lb.	.155-.165
Gold, Chloride, yellow, bottles	oz.	$18.75-$19.00
Cyanide, potassium 41%, bottles, wks.	oz.	$14.20-$14.95
Gum. Arabic, white, powder, bbls.	lb.	.33-.35
Hydrogen Peroxide, 100 volume, carboys	lb.	.16-.185
Iron Sulphate (Copperas), cryst., bbls., 1-4 wks.	lb.	.02
Lead, Acetate (Sugar of Lead), crystals, bbls.	lb.	.125
Oxide (Litharge), com., powdered, bbls.	lb.	.09
Magnesium Sulphate (Epsom Salts), tech., bbls.	lb.	.019
Mercury Bichloride (Corrosive Sublimate), crys.	lb.	$2.39
Mercuric Oxide, tech., red, powder, bbls.	lb.	$3.26
Nickel, Carbonate, dry, bbls.	lb.	.36-.365
Chloride, bbls.	lb.	.18-.20
Salts, single, 425 lb. bbls.	lb.	.13-.135
Salts, double, 425 lb. bbls.	lb.	.135-.145
Paraffin, refined, bgs., 123-125 a.m.p., c.l.	lb.	.052
Perchlorethylene, drums, l.c.l.	lb.	.095
Phosphorus, red, cases	lb.	.40-.44
yellow, cases	lb.	.23-.25
Potash, Caustic, 88-92%, flake, drums, works, c.l.	lb.	.07
Potassium, Bichromate, crystals, casks	lb.	.0975-.10
Carbonate (potash) calc., wks., drums	lb.	.065
Cyanide, 94-96%, dom. dms., wks.	lb.	.55
Pumice, ground, 1½ F. & coarser, bbls., wks.	lb.	.045
Quicksilver (Mercury), dom. 76 lb. flasks, net	flask	$191.
Rochelle Salts, crystals, bbls.	lb.	.44
Rosin, gum, D dms., dock	lb.	.036
Silver, Chloride, dry, 50 oz. lots	oz.	.455
Cyanide, 100 oz. lots	oz.	.41⅛
Nitrate, 100 oz. lots	oz.	.32⅝
Sodium, Carb. (soda ash), light, 58%, bags, l.c.l.	lb.	.0213
Cyanide, 96%, dom. 100 lb. drums	lb.	.15
Hydroxide (caustic soda) 76%, flake, l.c.l.	lb.	.0355-.049
Hyposulphite, crystals, bags, wks.	lb.	.0225
Metasilicate, granular, 1-9 bbls.	lb.	.0355
Nitrate, rfd., gran., bbls., wks.	lb.	.04
Phosphate, tribasic, tech., bbls., wks.	lb.	.0365
Pyrophosphate, anhydrous, bags, c.l., wks.	lb.	.0528-.061
Sesquisilicate, 1-9 bbls.	lb.	.043
Stannate, drums	lb.	.335-.365
Sulphate, anhydrous, bbls., works	lb.	.022-.024
Sulphocyanide, drums	lb.	.55-.65
Sulphur, Flowers, U.S.P., bbls., l.c.l. mine	lb.	.0415
Tin Chloride, crystals, kgs	lb.	.39-.395
Toluene (Toluol), 2°, ind., drums	gal.	.33
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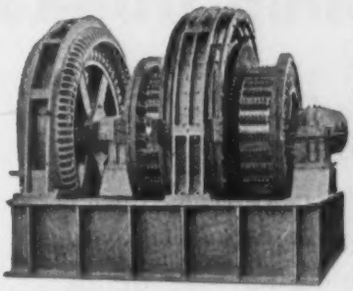

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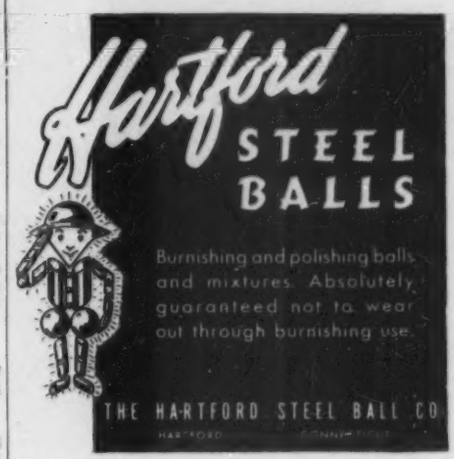
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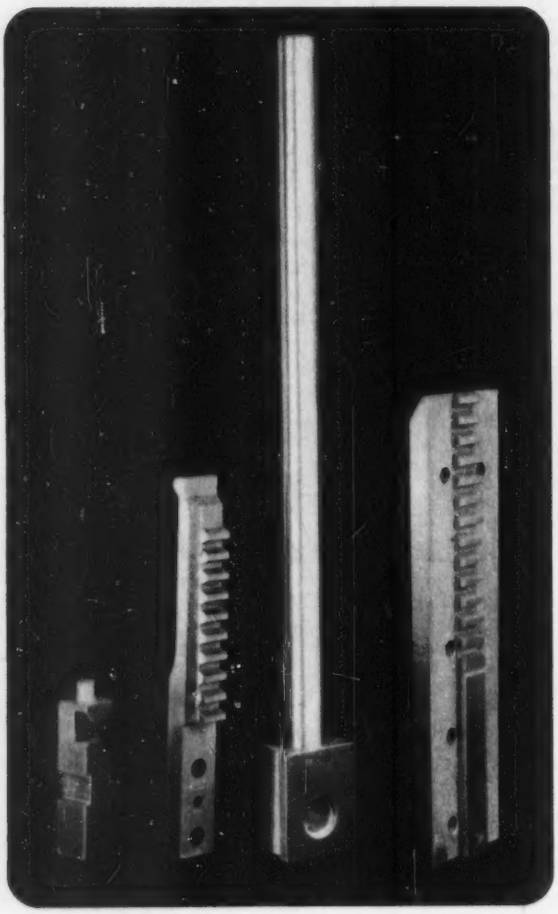

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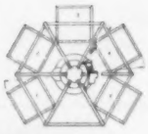

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ODDS and ENDS

Better Late Than Never Dept.:

A clipping from *The New York Times* of Nov. 1 was sent to us by Samuel Heiman of Battelle Memorial Institute but was received too late to make the December issue of this page and was crowded out of the January issue by Vox Humana and Season's Greetings. The headline of the clipping was "Plating by Radio" and the first sentence stated that "radio waves" are used to coat steel plate with tin. Don't you tin platers throw away your solutions yet—it was only the *Times*' interpretation of the induction heating of electrotinned steel sheet for melting and flowing the deposit, which process was described in the December 1942 issue of *Metal Finishing*.

We love to read the ads in trade magazines. Texas Gulf Sulphur Co. advertise "crude" sulfur—99½% pure. What a dirty material!! — only 99½% pure. When it is 99.99% pure, they probably conservatively call it "technical grade."

Union Bag & Paper Corp. state in one of their ads that they have boiled water in paper. Soon a plater who needs a hot-water rinse tank may be able to open a paper bag, fill it with water, and put a gas burner under it.

And speaking of ads, our analytical chemist, who once had aspirations of being a commercial artist (and still has), took a long look at the U. S. Stoneware ad on the back cover of January's *Metal Finishing* and opined that if he could think up layouts like that, he wouldn't have to get his fingers stained by nitric acid and silver nitrate.

We never knew until last month that all Fahrenheit had to do to get the temperature scale named after him and to be remembered after he was dead, was substitute mercury for alcohol in thermometer tubes. And we also heard the old one again about Franklin identifying electricity in lightning but it was the man who invented the electric meter who made all the money.

Myron Diggin of Hanson-Van Winkle-Munning called up to get information on Herbinium. Perhaps some readers can enlighten us.

Monthly Apologia: For the past three years we have been preparing, for the January issue of Metal Finishing, a summarization of the noteworthy developments presented in the technical literature during the preceding year. We always wondered whether any readers really went through the mass of fine print to the preparation of which we devoted our spare time each December; but the inclusion of a few personal comments therein this time settled this question once and for all.

We found out all right!! Comments, mostly sarcastic, have been pouring in from authors, their friends and their friends' friends.

Have a heart, boys!!—We were only fooling!! After all, if we didn't think the papers were good we wouldn't have mentioned them at all.

Prayer of the month: Please, Lord! Help me to keep my big mouth shut until I have something to say! Amen!

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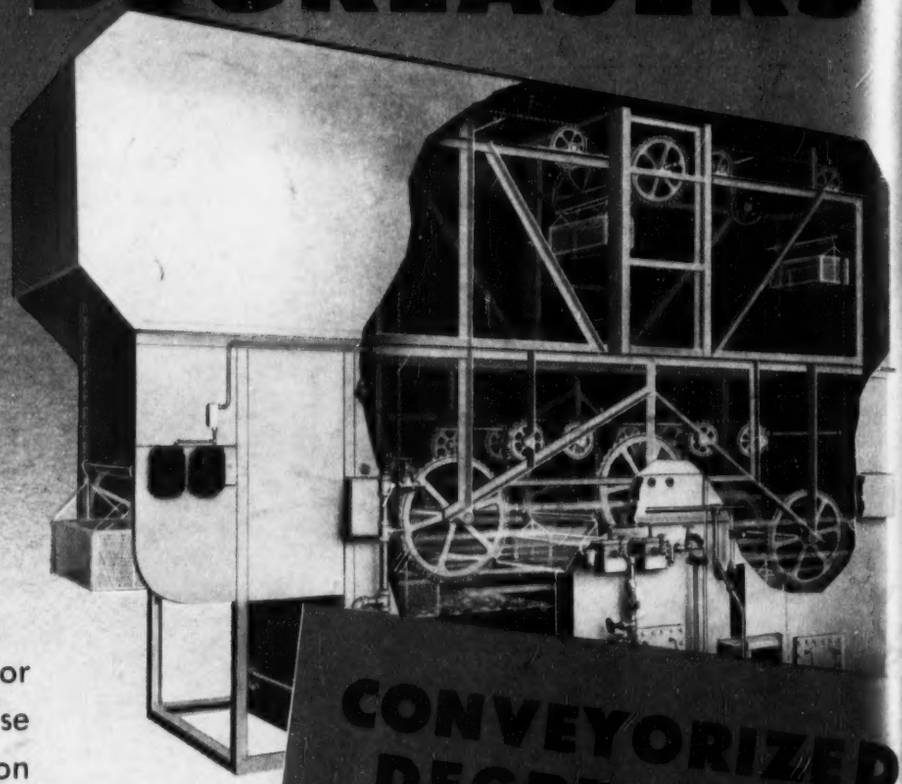

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